COMPTON'S
PICTURED ENCYCLOPEDIA AND FACT-INDEX

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TO INSPIRE AMBITION,
TO STIMULATE THE IMAGINATION, TO PROVIDE THE
INQUIRING MIND WITH ACCURATE
INFORMATION TOLD IN AN INTERESTING
STYLE, AND THUS LEAD INTO
BROADER FIELDS OF KNOWLEDGE,
SUCH IS THE PURPOSE OF
THIS WORK

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COMPTON'S PICTURED ENCYCLOPEDIA

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Here and There in This Volume

At odd times when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. With this as a guide, you may visit faraway countries, watch people at their work and play, meet famous persons of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list is not intended to serve as a table of contents, an index, or a study guide. For these purposes consult the Fact-Index and the Reference-Outlines.

Pictures You Will Enjoy

For the Reading Hour

Parent and Child; School and Home

High Lights in History's Pageant

Travel Views of Lands Across the Seas

In the Plant and Animal World

The Wonder We Call "Life"

Tours Through North and South America

Marvels of Science and Invention

Guideposts to Literature, Art, and Music

Exploring a World of Facts

Interest-Questions Answered in This Volume

Why do people living in the hot Sahara wear woolen robes? 16.
What bird's nests are used as food? 459.
Why were stilts invented? 395 picture.
What animal may be said to walk on its ribs? 205.
Why did the fruit growers of California import the Australian ladybug? 53.
What causes sound? 236.
What great interpreter of Bach's organ music became a famous medical missionary? 59.
How is silver used in photography? 188.
Why do so many foods not "taste" right when you have a cold? 200.
Why is the swan called the "royal" bird? 459.
What book written as a satire on human nature has become a children's classic? 468.
What English writer intended to reform the world but is remembered only for his poetry? 141.
What American novel helped to bring about a war? 424.
How is "salt" related to "salary"? 31.
For what type of musical composition is Schubert especially noted? 58.
What is "relief" in sculpture? 74.
Why did Shelley write the poem 'Adonais'? 142.
What fashion in literary composition did Sir Walter Scott set? 66.
What event stirred a khedive of Egypt to entertain more than 6,000 persons? 442*a*.
How do water spiders get air into their nests at the bottom of ponds? 346.
What do "mermaids' purses" contain? 190.
How do snakes hear? 209.
What familiar tree bears leaves of three different patterns? 49.
What fish are hatched out in a pouch in the body of the male parent? 87.
What animal spends nearly its whole life hanging upside down? 200.
Why is a bubble round? 214.
How many kinds of rattlesnakes are found in the United States? 207.
Where are the Bad Lands and how were they formed? 295.
What wars gave importance to sugar beets? 445-6.
How are wandering sand dunes kept at home? 38.
Where do temperatures sometimes reach 170°F. or more? 15.
What river has "reversing falls" where the water may flow in either direction? 18.
What bean is used for plastics and paint as well as for food? 308*b*.
Where is the "cold pole of the earth"? 172.
Would a sea cucumber make a good vegetable salad? 86.
Where is bull fighting the national sport? 317.
What were the seven wonders of the ancient world? 105, 106 pictures.
How is silk "weighted"? 185.
Why do swallows, unlike most birds, travel by day when migrating? 458.
How do spiders travel to islands hundreds of miles from the mainland? 344-5.
Are sponges plants or animals? 353.
How do we know that saber-toothed tigers once lived in California? 1.
Why do sycamores shed their bark? 486.
Does the flying squirrel really fly? 359*b*.
Why isn't spider thread used for making cloth? 343.
How do stones tell the progress of man? 401.
What ancient state had two kings at the same time and why? 329.
Why were Austria, Russia, and France referred to in the Seven Years' War as "the League of Three Petticoats"? 107.
What sea animal propels itself by sucking in and squirting out water? 54.
What is the physical difference between music and an unpleasant noise? 238.
How has science been able to tell what stars are made of? 331–2.
How has man changed the shape and character of sheep? 137.
What has the sun to do with the winds? 450.
Why is silver tarnished by egg? 447.
Why can't a snake close its eyes? 205.
How do we know that some stars are "dead"? 370.
If you were traveling 150 miles an hour, how many years would it take you to reach the sun? 450.
What influence did Savonarola have on life in Florence? 52.
How did the Bowery get its name? 434.
How did Sir Isaac Newton find that white light is really a mixture of colored lights? 331.
Who guessed the riddle of the Sphinx? 339.
How does a stickleback build its nest? 395.
Where may we see waterfalls four and a half times higher than Niagara? 277 picture.
Why are so many silos cylindrical? 186.
How are spruces distinguished from pines and firs? 358 picture.
From what fish do we get caviar and isinglass? 434.
Why is the sword considered the "most romantic of weapons"? 484.
How can people "talk" with flags and lights? 179.
For what change in the art of heating was Benjamin Franklin responsible? 424.
How many stars are believed to exist? 370.
Why do swordfish attack boats and ships? 485.
Tell briefly how the spice trade has affected the course of history. 339.
Why are some soils "warm" and others "cold"? 228.

KEY TO PRONUNCIATION

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index Marked letters are sounded as in the following words: cāpe, ăt, fär, fȧst, whạt, fall; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, dọ; cūre, bŭt, rṳde, fụll, bûrn; out; ü=French u, German ü; ġem, ḡo; thin, *th*en; ṅ=French nasal (Jeaṅ); zh= French j (z in azure), ᴋ=German guttural ch.

S

SABBATH. It has been said that the Sabbath is "a festival not of one city or one country, but of all the earth." A weekly day of rest has been found among almost all nations, including the ancient Egyptians, Babylonians, Hindus, Persians, Greeks, and Romans.

It has been said that the Hebrews derived their Sabbath from the Babylonians, but as observed by the Hebrews it acquired a new significance. It was a day of rest (the Hebrew *shabath* means "to rest"), but it was also a holy day, a memorial of the completion of creation on the seventh day and of the deliverance of the Israelites from Egyptian bondage. The Hebrew Sabbath is the seventh day of the week (our Saturday) and it lasts from sunset on Friday to sunset on Saturday. During this time all labor must cease; according to the fourth commandment it was forbidden also to cause servants or animals to labor.

Among Christians, the *first* day of the week, as the Lord's Day, the day of Christ's resurrection, early came to be regarded as more holy than the Hebrew Sabbath, and so Sunday came to supersede Saturday as a day of rest as well as a day of worship. The church transferred many features of the Jewish Sabbath to Sunday and designated that day as the Sabbath. However, there are some Christian sects which today observe the seventh day as their Sabbath. In addition to forbidding work on Sunday, many denominations discourage the playing of games, attending theaters, and similar amusements. The Roman Catholic Church requires its members to attend Mass each Sunday. Mohammedans keep Friday as the day for special religious services, but they are not required to rest from their labors except during the time of the midday prayer (*see* Day; Week).

SABER-TOOTHED TIGER. In the Old Stone Age lived a big cat, more ferocious in appearance than any known today. It was the saber-toothed tiger. Although no larger than a modern tiger, it had a deeper body, shorter and thicker legs, and almost no tail. The shoulders and loins bulged with muscles. The huge paws had retractile claws three or four inches long. But the weapons that make it a symbol of primitive ferocity were the two saber-like teeth curving down from the upper jaw. They were fully eight inches long, and the rear edge of each great fang was notched like a file for tearing flesh.

THE GIANT CAT THAT ONCE ROAMED AMERICA

Perhaps on the site of the city or farm where you live today, the saber-toothed tiger stalked its prey thousands of years ago. This painting by Charles R. Knight is displayed in the American Museum of Natural History, New York City, and is based on fossil remains found in tar pits.

In attacking, this killer probably struck with its saber teeth as a snake does with its fangs, stabbing and tearing its victims until they bled to death. To keep its lower jaw from interfering with the blades, this "stabbing cat" must have opened its mouth 16 inches or more.

Saber-tooths prowled all the continents of the world except Australia. They found plenty to kill and eat in North America, particularly in what is now California. There they pounced upon pony-sized horses, primitive camels and llamas, giant wolves, and buffaloes whose horns measured six feet from tip to tip. They even felled elephant-sized ground sloths that had lumbered up from South America along with giant armadillos and ox-sized glyptodons. Probably they fought with the "biting cats" (*Felis atrox*) which were about the size of lions. But they must have avoided the imperial elephants that stood 14 feet high.

Many saber-toothed tigers and their neighbors blundered into sticky tar pits where their bones are preserved today. The richest yield of their bones has come from the Rancho La Brea in Los Angeles. From these bones, scientists have been able to reconstruct the saber-toothed tiger in form, but the actual coloring and length of its hair are still a guess. Fossilized remains have also been recovered from bogs and caves in widely scattered areas of the world.

The last of the saber-toothed tigers died about 25,000 years ago, perhaps from starvation, disease, or the cold of glacial periods. The large saber-toothed tiger belongs to the genus *Smilodon* (Greek for "carving knife") of the cat family *Felidae*. The bones of a smaller and earlier saber-tooth (genus *Machaerodus*) have also been found in many parts of the world.

SACRAMENTO, CALIF. The towering dome of the statehouse rises like a golden crown from the center of the city of Sacramento, the capital of California. The city is the most important marketing and manufacturing center of the Great, or Central, Valley of northern California. This rich agricultural valley is watered by the Sacramento and San Joaquin rivers. The Sacramento (Spanish for the "Sacrament") is the state's largest river. To the east rises the Sierra Nevada, snow-capped the year round, and to the west the Coast Range. The capital occupies a loop near the junction of the Sacramento and American rivers. Sacramento is 75 miles northeast of San Francisco.

In 1839 Capt. John A. Sutter sailed up the Sacramento River from San Francisco Bay and established a colony on the present site of Sacramento. He called it New Helvetia for his former homeland, Switzerland. Two years later he built a fort to protect his Mexican land grant of 11 square leagues.

On Jan. 24, 1848, James W. Marshall discovered gold at Sutter's sawmill, located at Coloma in the foothills east of Sacramento. When the word went out to the world, it started one of the greatest migrations of people ever known. Within a few months Sacramento became a thriving headquarters for the gold seekers. Bret Harte's stories about their mining camps are still read. The same year the streets were laid out and the town was named after the river. Six years later it became the capital of California.

Clipper ships brought their cargoes of men and supplies around the Horn, entered San Francisco Bay, and sailed up the river. In the days of the "glorious 60's and 70's" luxurious passenger boats plied the river between San Francisco and Sacramento.

The miners used hydraulic machinery to wash out the gold. This process washed whole mountainsides into the river, reduced the channel to half its depth, and caused floods which required levees for control.

The state's first railroad linked Sacramento to Folsom in 1856. The city became the western terminus of the Pony Express in 1860 and of the first transcontinental railroad, the Central Pacific, in 1869.

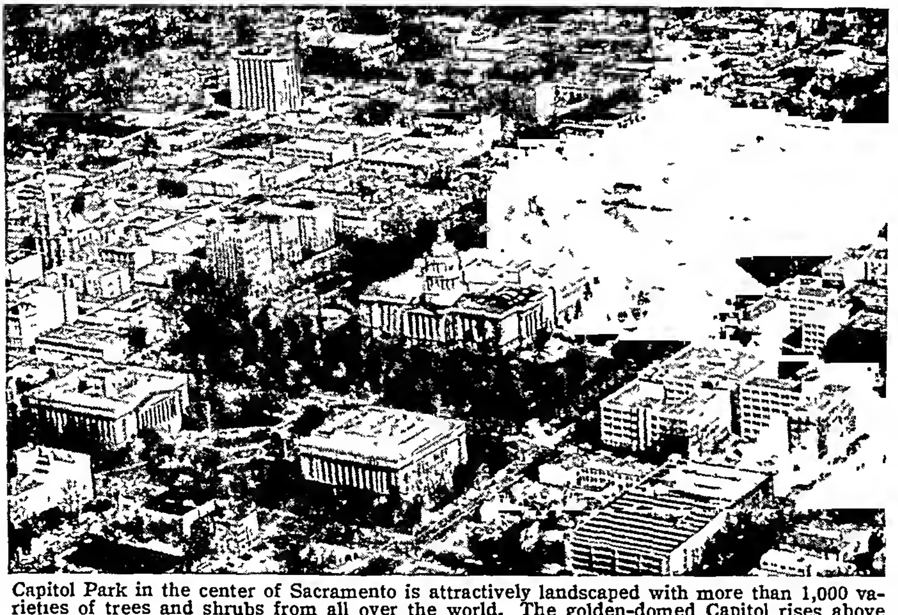
A wheat boom succeeded the gold rush and the Great Valley became a world granary. The reign of wheat, however, was short lived. High railroad freight rates, competition from Mississippi Valley wheat fields, and population growth encouraged more intensive farming.

With the introduction of irrigation, a new era dawned. The valley became one of the most important truck-farm areas of the United States, producing a wide variety of crops (*see* California). The city is now an extremely important center for fruit and vegetable canning. Within 25 miles of Sacramento about one half of the nation's canning tomatoes are produced. The area near the capital is also a great producer of rice, hops, almonds, meats, and peaches. About $1\frac{1}{2}$ million cans are manufactured daily in the city. Other important industries are soup, detergents, jet propellants, printing, and cartons and boxes.

Thousands of people work in state and federal government offices, military installations in the area, and the huge shops of the Southern Pacific and Western Pacific railroads. Transportation is provided by these railroads, plus the Sacramento Northern, three airlines, and barges on the Sacramento. The ten-foot channel is being deepened to create an inland port for seagoing freighters. Mather and McClellan Air Force bases are nearby.

The city is handsomely built. Its many fine public buildings include the State Capitol, the California State Library, a state college, the Memorial Auditorium, and a stadium seating 23,000. Sutter's Fort has been restored; its museum houses relics from pioneer and gold-rush days. Crocker Art Gallery has many fine art objects. The California State Fair is held on the fairgrounds. In 1921 Sacramento became the first city in California to adopt council-manager government. Population (1950 census), 137,572.

SACRAMENTO'S HANDSOME CAPITOL PARK



Capitol Park in the center of Sacramento is attractively landscaped with more than 1,000 varieties of trees and shrubs from all over the world. The golden-domed Capitol rises above the foliage. The twin buildings house the state offices and the State Library and courts.

SAFETY—*A Challenge to* COMMON SENSE *and* SKILL

Symbolic of the safety movement is the school safety patrol in his white belt and chest band. With arms outstretched, he holds back his schoolmates until the street is clear. Children have learned to accept his authority without question.

SAFETY. There is an old saying, "Accidents will happen," yet only a few accidents just "happen." Most of them are caused by ignorance, carelessness, or lack of skill.

Babies do not fall out of windows if the windows are closed or have strong screens. Skillful automobile drivers and expert swimmers rarely have accidents. People who know how to handle electrical appliances seldom suffer from electric shock. Very few factory workers get seriously hurt if the company has installed proper safety devices and maintains a program of safety education.

Beyond doubt a large proportion of accidents can be prevented. Industrial plants which have intensive safety programs have cut their accident rate in half in only a few years. Safety education in the schools began on a national scale in 1922. In the next 29 years, accidental deaths among children of elementary-school age were reduced by 36 per cent. This gain was made even though the number of automobiles in use increased by four times during these years, thus greatly increasing possibilities for accident.

The Tremendous Cost of Accidents

Despite all that has been done, accidents still cause more than 90,000 deaths every year in the United States. During the second World War about 275,000 American military personnel were killed in action, but this number and some 80,000 more Americans died in accidents. About 9 or 10 million persons are seriously injured every year. This is about equal to the population of both New York City and Philadelphia.

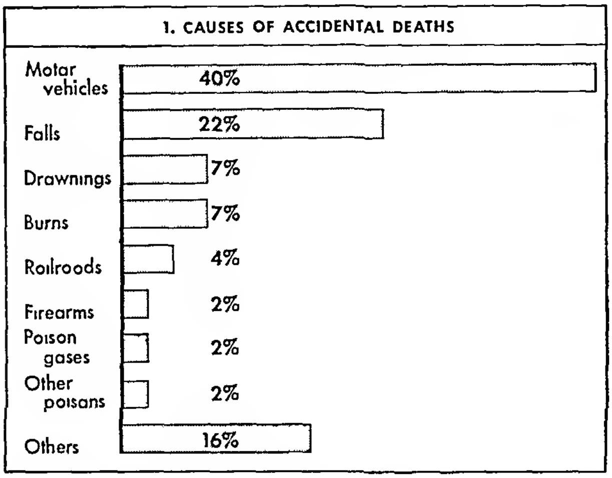
No one can estimate the loss that these deaths and injuries cause the American nation in broken homes and in suffering. In terms of money, the loss each year is staggering. The amount of income lost by disabled or deceased persons is nearly 3 billion dollars. Medical care costs nearly another half billion dollars. Added to this are administrative costs of insurance of one billion dollars. Property damage in motor vehicle accidents and by fire totals more than 2 billion. Property destroyed and production lost due to occupational accidents account for almost another $1\frac{1}{2}$ billion dollars. The total accident bill is nearly 8 billion dollars. This represents $190 for each household.

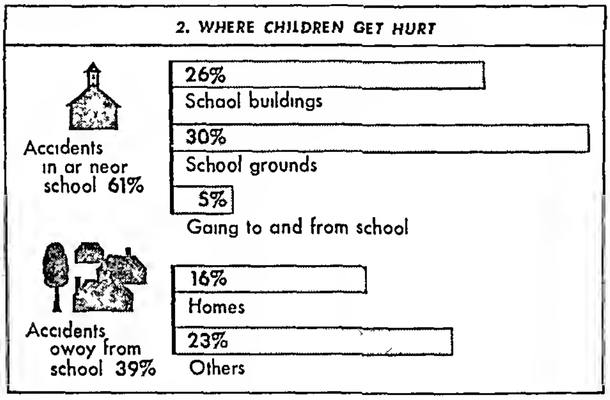
Careless Americans

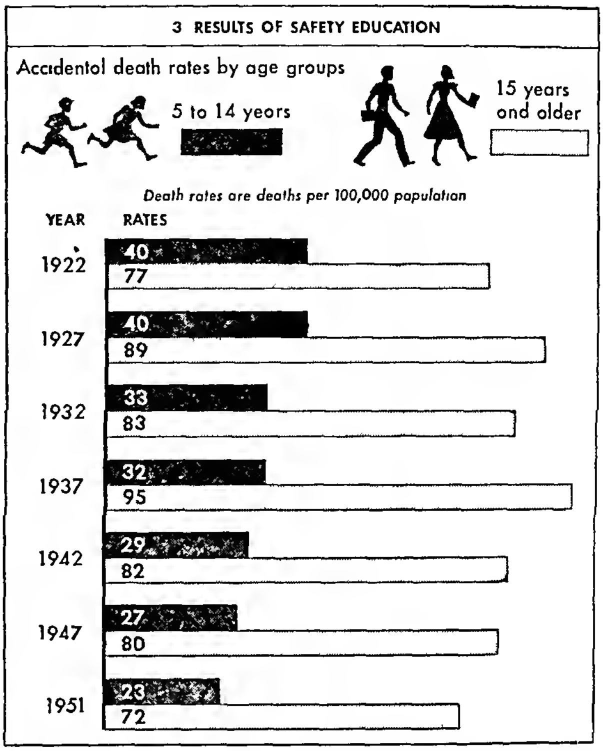
The United States has a higher accidental death rate per 100,000 population than all but a very few countries. This high death rate is due largely to the fact that the nation has more automobiles, railroads, electrical appliances, and other machines than any other country.

How can we prevent accidents? First, we can make our surroundings safer. We can reduce hazards in our homes, where one half of all accidents happen. We

WHERE SAFETY EDUCATION IS NEEDED MOST







1. This graph shows the causes of accidental deaths in the United States. The bars representing motor vehicles and railroads both include rail crossing accidents. 2. During the school year more children get hurt in or near school than in any other place. 3. School safety education began in 1922. Since then the accident rate for younger children has gone down. The rate for older persons, however, remains about the same.

can reduce hazards in public buildings, streets, transportation agencies, factories, and mines. Second, we can all develop "safety alertness" by following the rules laid down later in this article.

Growth of the Safety Movement

The first work in accident prevention was undertaken by industry. This grew out of the horrifying number of accidents that followed the introduction of machinery in the 18th and 19th centuries (*see* Industrial Revolution). Beginning about 1867, many employers in Europe formed accident prevention associations and installed devices to make machinery safer. Soon afterward, beginning in England in 1880 with the Employers' Liability Act, laws were passed permitting disabled workers to sue for damages. These were followed by "workmen's compensation acts," which forced employers to carry insurance for injuries. Similar compensation laws were passed in the United States, beginning with Maryland's law in 1902. (*See* Employers' Liability.)

In the United States the next great forward steps were taken in 1907, when the Association of Iron and Steel Electrical Engineers began to promote safety work, and in 1913, when the National Safety Council was organized. The Council is a co-operative association which analyzes accident causes and promotes safety education. Among the organizations that belong to the Council are local safety councils, automobile clubs, schools, industrial associations, chambers of commerce; departments of federal, state, and city governments; and manufacturing, public utility, insurance, and transportation companies.

The Schools and Safety Education

Since the start of safety education on a national scale in 1922, many thousands of children have been saved from accidental death. In that year one out of every eight persons killed by accident in the United States was a child between 5 and 14 years old. Now, children of this age group contribute on the average only about one sixteenth of the total. Their accidental death rate is lower than that of any other age group. In some cities, a program of stressing safety education and safety measures has reduced child motor-vehicle fatalities by 75 per cent.

In alarming contrast to this record for the younger children is the large increase since 1922 in the traffic accident death rate for the group which includes youths of senior high-school and college age—between 15 and 24. In the hope of reducing the accident rate in this group, safety education is being extended into high schools and some colleges and universities. Many high schools are now giving courses in driver education and driver training.

Public Measures to Make Driving Safer

Nation-wide improvement of highways and of traffic regulation has helped to make driving safer.

In 1924 Herbert Hoover, then secretary of commerce, called the first National Conference on Street and Highway Safety. Since that time, the national motor-vehicle death rate (based on mileage) has dropped more than one-half. Some states and cities have reduced their motor-vehicle death rate even more.

Engineers make traffic surveys, widen highways, straighten curves, put up warning signs at danger spots, and build divided highways with controlled entrances and exits. They also construct separate grades at highway intersections and at rail-highway crossings. Other safety measures include stop-and-go lights, one-way streets, stop streets, safety islands, low-speed limits in business and school areas, and special rules for trucks (*see* Automobile).

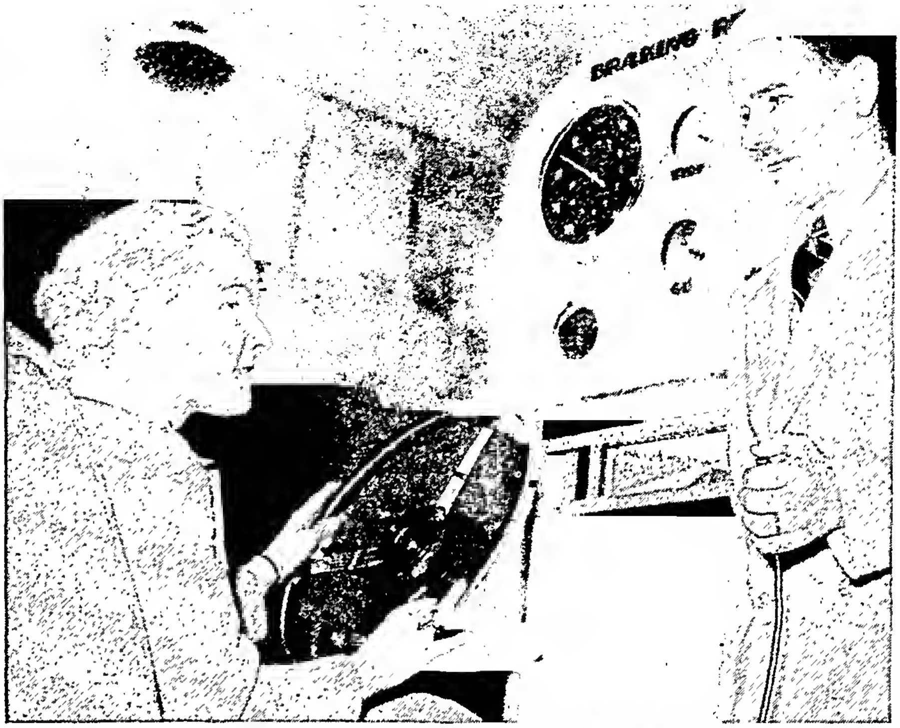
City and state police departments have devised new prevention measures by scientific study of accident causes. Some cities compel traffic violators to attend "safety schools" directed by the police. To reduce danger from cars in poor mechanical condition, many states and cities require tests for brakes, lights, and other equipment. Cars and tires now are built so soundly that mechanical failure is rare except through misuse or neglect on the part of the driver.

Educating and Testing Drivers

Thousands of organizations are helping to educate the public. Newspapers call attention to traffic hazards and print driving lessons. Magazines and radio programs warn drivers and pedestrians of carelessness. Insurance companies, gasoline distributors, and automobile clubs promote safe driving by booklets, advertisements, posters, and emblems mounted on cars. Through the Automotive Safety Foundation, established in 1937, the automobile industry contributes hundreds of thousands of dollars a year to schools and organizations for safety training. Parent-teacher associations are especially active in promoting safety education in the schools. The Red Cross, 4-H Clubs, the Boy Scouts, the Girl Scouts, and the Camp Fire Girls also do a great amount of educational work.

Despite these efforts, traffic accidents are in most years the largest single cause of accidental deaths. The yearly toll is about one-third of all fatalities. By far the greater number of these accidents can be prevented by safety education, as is proved by the remarkable records of some trained commercial drivers. Many safety-trained drivers of trucks and motor busses have greatly reduced their accident death rate during periods when the death rate for privately driven vehicles increased. Many states require drivers to pass an examination in driving skill and physical fitness to obtain a license to drive. Almost all states made large reductions in their motor-vehicle death rate from 1937 to 1949.

TESTING A DRIVER FOR REACTIONS TO EMERGENCIES



How fast can you apply the brakes in an emergency? How accurately do you estimate the speed and distance of an oncoming car? Are you excitable? These and other factors that mark the safe driver can be tested by the apparatus shown above. It was devised by the Yale Bureau of Highway Traffic (formerly Harvard's Bureau for Street Traffic Research).

Another approach to the traffic accident problem has been the study of the "accident-prone" group of drivers. These people have far more than their share of mishaps. This study uses tests to discover dangerous mental and emotional weaknesses before the driver has an accident. Many "accident-prone" people can improve their driving if they recognize their defects and strive to overcome them.

How the Federal Government Promotes Safety

The Federal government does much safety work. In 1950 the president created the Federal Safety Council to safeguard government employees from accident and health risks. Through its Bureau of Safety, the Interstate Commerce Commission inspects railroad and motorbus and truck lines' equipment to insure safe operation. The Civil Aeronautics Board safeguards air travelers by examining pilots, inspecting planes, and conducting studies in accident prevention.

Ships must be approved and their officers and other personnel licensed by the Coast Guard, and seamen must meet requirements authorized by Congress. The Coast Guard also supervises waterways and maintains lighthouses and other aids to navigation. It also patrols the North Atlantic to reduce hazards from icebergs. The Coast and Geodetic Survey charts navigable waters and provides other information for the safety of mariners.

Weather information for ships, railroads, air lines, and other transportation agencies is supplied by the Weather Bureau. Safe highway engineering is promoted by the Public Roads Administration.

The Forest Service keeps an army of men at work to prevent and check forest fires. Under the direction of the army engineers, a vast flood-prevention program protects life and property from the Mississippi and other rivers. From the Office of Education, safety literature and radio programs are sent to the nation's schools. Statistics compiled by the Bureau of the Census on the causes of accidental deaths are important sources of information.

Industrial safety is promoted by the Bureau of Labor Statistics. This bureau studies causes of accidents and recommends preventive measures, such as rest periods for workers, better lighting conditions, and protection of dangerous machines. Accidents in mining, one of the most hazardous industries, have been considerably reduced by the Bureau of Mines. Since 1941 it has inspected mines, and its experimental stations do research in safe mining and quarrying methods. The Bureau teaches miners first aid and rushes specially trained "mine rescue" crews to mine disasters. Danger from dust explosions in mines, grain elevators, and other places has been reduced by research in the Bureau of Agricultural and Industrial Chemistry. Safety of materials and design is advanced by the National Bureau of Standards, which does a vast amount of research, such as testing materials for strength and for fire resistance, setting specifications for electrical equipment, and developing higher standards for building construction. This branch of the Department of Commerce is managed by distinguished scientists.

State and Municipal Safety Measures

Each state has its own laws on safety. They are administered by such state agencies as the department of labor, the fire department, police, industrial commission, division of factory inspection, bureau of mines, highway commission, and commerce commission. Some laws require fireproof material in certain types of building. Others govern installation and operation of machinery, requiring, for example, automatic machinery stops and shields or guards for all moving parts that might maim workers.

Many states enforce national *safety codes*. These are rules drawn for various industries by the American Standards Association, with the cooperation of the National Safety Council, and by other similar agencies. Under them, employers must provide proper lighting and ventilation, safety education for workers, and special equipment for dangerous work. Such equipment includes safety helmets for miners, tunnel drillers, and steel workers, and shatter-proof goggles for metalworkers and woodworkers.

Cities protect the safety of their people in nearly every activity of daily life. Fire departments by their prompt work save many lives, and they prevent fires by inspecting buildings and neighborhoods for fire hazards. When a crime or disaster occurs, police in patrol cars and on motorcycles are notified by radio so that they can speed to the scene to protect the lives of citizens. Police also prevent many accidents and deaths by enforcing the traffic laws. Building departments inspect elevators, stairways, boilers, and other structural hazards. Water mains, sewer pipes, sidewalks, and streets are kept in repair by other municipal agencies. Cities are increasing their lighting facilities, since good street lighting is an aid to traffic safety and a deterrent to crime. To centralize these manifold activities, many cities have established safety commissions directed by experts known as safety engineers.

LABORATORIES HELP TO MAKE FACTORY AND HOME SAFER

The National Bureau of Standards, and the Underwriters' Laboratories, sponsored by the National Board of Fire Underwriters, test building materials and appliances. Above, an investigator is testing electrical equipment for defects which might cause dust explosions.

Growth and Value of Safety Engineering

Safety engineering is a relatively new profession, but it is taught at several universities, and foundations have been established to extend it. Originally it was concerned chiefly with industrial safety, training engineers to develop safety devices for machines and safe methods of operation. The profession has now grown to include traffic and community safety, and such training is given to the police departments of many cities.

Safety engineers are also employed by industrial companies, for industry has learned that safety means profit. Accident prevention in factories saves the time

of both workers and machines, and hence increases production. It also brings lower insurance rates. Mechanical hazards have been so reduced that today machinery is involved in only some 12 per cent of industrial accidents. The development of automatic safety devices is an important factor. Some devices stop machinery the instant it reaches a dangerous speed. Others halt falling elevators, blow away poisonous fumes, or quench fires. Railroad accidents are prevented by automatic signal blocks and by air brakes. Transport planes glide to safe landings through use of the radio beam and other aids.

With four fifths of industrial accidents traceable in some measure to the "human element," increasing stress is being put on safety education of workers. About 40 per cent of industrial accidents result from falls and from slipshod ways of handling boxes, tools, and other objects. Employers use posters, movies, courses for training in the correct use of machines, tools, and other elements of the work, and safety contests to teach carefulness. Applicants are tested for physical fitness for specific jobs. In transport, for example, engineers, drivers, and pilots are tested not only for general physical fitness, but for color blindness as well. Applicants also are tested to find whether they belong to the "accident-prone" group of people who are likely to have more accidents than others in the same work.

Common Accidents and How to Prevent Them

BUT SAFETY engineers and public agencies can do only a part of the work of cutting down the accident toll. Most of the responsibility must fall on the individual—on *you* and your fellow citizens. At home and at school, on the road, on the farm, and in all out-of-door activities, the problem of safety is chiefly a personal problem.

"Safety through skill"—that excellent slogan of the Boy Scouts—should be the motto of everyone. For skill usually means safety. Accidents rarely happen to experts. They know the right way to do things and the way to avoid unnecessary dangers.

1. HOME SAFETY

Home should be the safest place of all, but carelessness makes it one of the most dangerous. Because we keep on using tables and chairs as ladders, misusing kitchen appliances, and leaving things on the stairs for someone to trip over, more persons are killed in home accidents than in all the factory, mine, railroad, and farm accidents put together.

How to Guard against Falls

Falls are the largest single cause of home accidents. Stout window screens and gates at the top of stairs will protect small children against falls from windows and down stairs. Every staircase should have a strong handrail and should be well lighted. Loose treads and bulging pieces of stair carpet should be fastened down. Mops and brooms should be put in closets, not left to clutter cellar stairs. A night light or an extension cord reaching to the bed will save many a bump and fall in the bedroom. Small rugs on polished floors should be kept from sliding by a rubber backing or by fastening them down, especially when they are at the top or the bottom of stairs. A rubber mat and a hand grip will prevent slipping in the bathtub. Many kitchen falls can be prevented by smoothing warped linoleum, and wiping up spilled water and grease. Avoid using a table or a chair as a makeshift "ladder." A stepladder must be true to the floor and folding legs should be fully extended.

Safeguards against Burns and Fires

About three fourths of all fatal burns occur in the home. A large number result from careless use of kitchen equipment. Handles of pans should be turned inward from the edges of the stove. This is especially necessary to protect small children, for burns and scalds are among the commonest injuries to them. When cooking with deep fat, one should stand back to avoid grease spurts. To avoid steam scalds, lift the utensil cover so that the steam escapes from the *far* side of the pan. (For other safeguards, *see* the subhead "How We Can Help to Prevent Fires" in the article Fire Department.)

Guarding against Electrical Accidents

Nearly every electrical accident can be prevented when you know and remember two things: (1) the human body can conduct electric current; (2) any object becomes a conductor when it is wet. Severe electric shock paralyzes the muscles. If the heart muscles are paralyzed, death results immediately. If the lung muscles are affected, artificial respiration should be applied at once.

Before repairing any electrical appliance, disconnect it by pulling the plug from the socket. Merely turning off the switch is not enough, for the switch or the wiring may be faulty, permitting the current in the house circuit to give you a shock. Before repairing wall sockets, lighting fixtures, or other equipment that cannot be detached from the home circuit, shut off the current at the fuse box by removing the appropriate fuse or opening the main line switch. For all electrical work, use tools with insulated handles, and avoid touching two wires or appliances at the same instant. Take care not to touch any plumbing fixture at the same time that you are touching a wire or appliance. Do not use both hands to connect or disconnect an appliance. Modern home wiring has become so complicated that repair work and permanent installations should be entrusted only to a qualified electrician.

When hands or feet are damp, even with perspiration, avoid touching any appliance; and do not switch an appliance on or off or touch a wire when you stand on a damp floor. It is best to have wall switches for all bathroom fixtures; if a chain-pull is used, it should be fitted with a porcelain or fiber "interrupter." Do not touch a switch and any metal, such as a faucet, at the same instant. No electric appliance that requires

handling, such as a curling iron or a heater, should be used in the bathroom. Every basement fixture should be controlled by a push-button switch. When using electric washers or other laundry appliances in the basement, wear rubbers or stand on a piece of dry wood.

"Live" Wires and Short Circuits

Never touch a dangling or broken outside wire. Any wire, even a radio antenna or telephone line, may be "live," for it may have sagged or fallen against a high voltage line. If an outside power line breaks, keep people away and notify the electric company or the police station. If a person or animal has been shocked, do not touch him, but push the wire away with a dry piece of wood or a heavy cloth. If possible, stand on wood while doing this. Then apply artificial respiration (*see* First Aid).

All wires in the home should be insulated with stout covering, since cheap insulation wears rapidly. Defective insulation may start a fire by permitting exposed wires to touch each other and thus short the circuit. Avoid laying wires beneath carpets or over nails where rubbing will wear them. All appliances should show the seal of approval of the Underwriters' Laboratories. Moreover, an appliance should not be cleaned with a damp cloth while attached, since it may have an unnoticed short. Fluorescent light tubes require special handling. Some tubes may release a poisonous powder when they are broken.

When a fuse blows, remove the cause before inserting a new fuse. Never use a piece of metal in place of a fuse. The substitute will allow the short to continue, thus building up a dangerously heavy load of current. The same danger arises from installing a larger fuse. Most household branch circuits should use fuses of not more than 15 amperes. Before replacing a fuse, switch off the current. Use only one hand to screw the fuse, and keep the other off the fuse box or any metal part.

Protection against Gases and Poisons

Gases from oil, coal, and gas stoves and from automobile exhausts are dangerous hazards. Some of these gases can be detected by their odor, but one of the deadliest, carbon monoxide, is odorless (*see* Carbon Dioxide and Monoxide). Hence even the smallest leaks are dangerous. See that gas cocks are completely closed, and if you smell escaping gas extinguish all flame, including the pilot light on the gas range, and open the windows before looking for the leak. And of course, when hunting in the dark for a gas leak, use a flashlight—not a match. Gas stoves should have vent pipes leading to a chimney or outdoors. Furnace fires should be carefully banked at night. Hot-air furnaces should be frequently inspected for leaks which may admit gas to the register pipes. Garage doors should be opened before an automobile engine is started.

The best safeguard against poisons is to "watch what you are doing." Before using medicine, read the label. All poisonous materials—such as certain medicines, ammonia, caustic soda, and lye—should be locked in a box and put out of reach of young children. (For antidotes, *see* First Aid; Poisons.)

Importance of Clean Yard and Walks

In icy weather walks should be spread with ashes, sand, dirt, or salt. Put rakes and other tools where they will not trip people. Remove "collision" hazards —take down the clothes line before dark and prune bushes back from walks and doors. Nails, broken glass, and other trash should be put in a basket.

2. SCHOOL SAFETY

Many schools have Junior Safety Councils or other student organizations which act as steering committees for safety work through the school. Safety patrols from the upper grades prevent traffic accidents by directing pupils to cross the streets near the schools at the right times and places. (A handbook telling how to organize councils and patrols may be obtained for a small sum from the National Safety Council, 425 N. Michigan Ave., Chicago 11, Illinois.)

But safety at school, as elsewhere, depends most of all on the individual. Every child must coöperate by forming the right habits, learning the proper skills, and "thinking of the other fellow."

Falls can be reduced by keeping schoolroom furniture in orderly arrangement, desk drawers shut, and feet beneath the desks. Pencils, pens, scissors, and other sharp articles should be kept with ends pointing into the desk. As some 20 per cent of accidents in the school building occur in halls and on stairs, reduce the hazards of falls by walking, not running.

Gymnasium, Vocational Shops, and Playground

Obeying orders is one of the chief ways to prevent accidents in the gymnasium, where more than one-third of accidents in the school building occur. Avoid trouble by remembering it is childish to "show off." Do not try new "stunts" till the instructor trains you. Wear well-tied shoes with ridged-rubber soles to prevent slipping. Keys, penknives, pencils, and other hard objects should not be carried in gymnasium clothes. Do not leave soap on the shower-room floor. In the swimming pool, be alert. Before diving, see that you will not hit a swimmer. Walk on the rubber mat instead of the wet tiles and do not run.

Swings and other playground equipment should be tested each time before being used and defects reported. Students should ask the instructor for a demonstration before trying new kinds of equipment. When using rings and swings, look to see that no one will be struck when the equipment is released. Baseball, "catch," tag, and other running games should not be played near young children.

Kitefliers must be aware of the danger of getting a bad electrical shock if a damp kite string comes in contact with a live wire. For the same reason, wire should never be used in place of a cord or in connection with it. If a kite gets tangled around a wire, leave it alone. Many fatal accidents are caused by trying to get kites down from wires.

In school laboratories and shops, as in industry, most accidents can be prevented by handling equipment and machinery correctly. That is why instructors

SUGGESTIONS FOR AVOIDING ACCIDENTS AT HOME

1. Disconnect electrical appliances before starting to repair them. Keep cords in repair, as frayed insulation and exposed copper wires may cause short circuits and shock. 2. Never leave a small child alone in the kitchen; he may turn on the gas jets, touch the hot burners, or upset cooking utensils. Turn the handles of pots and pans so that he cannot reach them. 3. Use a stepladder—not a chair, stool, or box—to hang pictures and curtains or to reach a high shelf. 4. Never touch electrical appliances with one hand and a water faucet with the other; and especially never use them while in the bathtub. Water is a conductor of electricity, and if the appliances are faulty the current will travel to the water through your hody. 5. A ruhher mat in the hathtub and a hand-grip in the wall will prevent falls. 6. Keep stairs clear of toys and other articles. Keep your hand on the hannister. Stairs should he well lighted, and small rugs at top and hottom should be held down hy mats or hy suction devices to keep them from slipping.

LEARNING TRAFFIC SAFETY IN SCHOOL

If these first-grade children obey the rules their city policeman is teaching them, they will cross streets safely. The policeman tells them to cross only at corners, to wait on the curb until the green panel lights, and then to look both ways to make sure that all traffic has halted before they step down from the curb and start across the street.

teach certain ways to perform laboratory experiments, to use tools, and to operate machines. Short-cut methods are not "just as good." In chemical laboratories the chief hazards to guard against are poisonous fumes, explosions, and burns caused by carelessly getting too near the almost invisible flame of the Bunsen burner. To avoid entangling clothes in shop machinery, sleeves should be rolled above the elbows, tie removed, and work apron fastened securely. Machines should be stopped before stock is removed. Goggles should be worn for grinding, chipping, welding, and lighting a furnace. A solder furnace should be opened before lighting to avoid possible explosion from gas leakage. When working with a plane or other sharp-edged tool, *push* the tool so that the sharp edge moves from you—do not pull it toward you. Hold a chisel well up on the handle. When using a screw driver, place it true in the screw head and turn it slowly; with jerky turns, it may slip and cut your fingers. Before sawing, fasten the stock in a vise. Hammer heads and handles should be tight. Tools should not project over the work bench or lie on the floor, and spilled oil should be immediately wiped up.

3. STREET SAFETY

It takes two to prevent motor-vehicle accidents to pedestrians—the driver and the person on foot. Sometimes even the best driver cannot avoid an accident when a pedestrian acts foolishly or stupidly. Of every four pedestrians killed on streets and roads, three were violating traffic laws or acting in an obviously unsafe manner. In this motor age, pedestrians must form safe walking habits and they must exercise good judgment. Above all, they must have a co-operative attitude toward drivers.

Among the commonest causes of street accidents are walking against traffic signals, crossing streets without looking to see if a car is coming, darting out from behind parked cars, and entering or leaving cars on the left side.

Correct Way to Cross a Street

Cross busy streets only at intersections. Observe traffic lights. Before crossing at unprotected corners, look in all four directions, not just two, and wait if an automobile is coming. Even if the driver sees a pedestrian at once, it may take him as much as three quarters of a second to apply his brakes. Tests show that a driver going 20 miles an hour travels about 52 feet before he stops his car; 30 miles an hour, 100 feet; 40 miles an hour, 164 feet; 50 miles an hour, 243 feet. When streets are wet or icy, the driver may not be able to stop in less than half a block even at low speed. Darkness more than doubles the risk of the pedestrian. It is harder for the driver to see at night and harder for the pedestrian to judge the speed of an approaching car. It is best to wear or carry something white that will show up in the beam of the headlight.

Bicycle Riders and Roller Skaters

Good bicycle riders must be able to ride without wobbling and to make quick stops and turns. A bi-

cycle should be equipped with bell or horn, headlight, and taillight or red reflector. A white handkerchief tied on the upper arm will help drivers at night to see a rider at a distance. Cyclists should obey traffic rules, ride along the right curb, travel in single file, and signal before turning. Before crossing through streets and before riding from alleys, they should stop. Special care should be taken at intersections, for half or more of rider injuries occur at crossings. Good riders do not carry passengers on handlebars or try trick riding in traffic. Only foolish riders hitch on other vehicles.

Roller skaters should practice quick stops and turns. They should take off their skates and walk across busy intersections. Skaters should give pedestrians right of way and go in single file when passing.

4. DRIVING SAFETY

Young motorists have special responsibility to improve their driving skills. Studies of traffic accidents show that drivers under 20 years of age have somewhat more than their share of accidents in proportion to the number of such drivers.

The good driver always obeys every traffic law and rule of the road (*see* Automobile). Moderate speed is best at all times. Research shows that at speeds under 20 miles an hour, only one rural accident in 50 results in death; at speeds of more than 60 miles an hour, one in 6 is fatal. Granting the right of way to another driver will save many collisions. On long trips, eat lightly; and every two hours, get out and move about a few minutes. In country driving, watch for automobiles coming from sideroads or farmhouses. One should make a complete stop for livestock and then pass them slowly.

Handling a Skidding Automobile

Using the engine as a brake is helpful in stopping on wet or icy pavements. This is done by pressing on the foot brake *without* disengaging the clutch. To stop on slippery pavements apply the brakes gently and repeatedly instead of in one continuous action. Do not coast down hills but keep the clutch engaged. Shift into second speed or low for steep hills. Do not apply the brake while going around a curve; it may bring on a skid or an upset. Slow down before reaching the curve; then, after your car starts the turn, give it more gas. Thus the driving force of the rear wheels will offset the tendency to skid and sway.

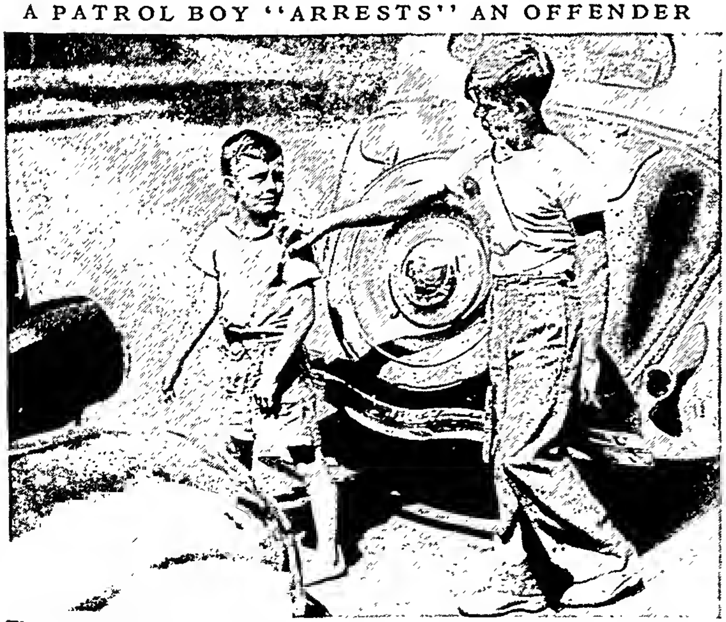
If skidding starts, braking will only make it worse. Instead, accelerate slightly and turn the front wheels in the *same* direction as the skid. If a blowout occurs, do not brake but take your foot off the accelerator and let the car come to a gradual stop.

Make it a habit, even on empty roads, to keep over on the right-hand side. Never turn out into the left-hand lane to pass a car unless you can see that no cars are coming toward you. Never try, under any circumstances whatsoever, to turn out around a car near the top of a hill or on a blind curve. You will not be able to see oncoming cars until it is too late to avoid a head-on collision, which is usually fatal.

Courtesy to Other Drivers

Many accidents are caused indirectly by drivers who are careful of their own safety but inconsiderate of others. If an autoist persistently straddles two lanes of a highway, he forces those who want to pass into a dangerous situation. And the man who holds up traffic behind him by driving at 20 miles an hour on a road where the legal limit is 35 or 40 miles may consider himself responsible for the accident that may result when some exasperated driver in his rear takes a risk to get past. The autoist who chooses to drive very slowly should keep off the main highways, or he should watch the road behind in his rear-view mirror, and when he sees he is holding up other cars he should turn off the road to let them pass.

A PATROL BOY "ARRESTS" AN OFFENDER



The boy on the left will have to go before the school traffic court for running between parked cars. He may be penalized by extra duties or loss of privileges. Such courts are useful in safety education.

5. SAFETY IN OUT-OF-DOOR SPORTS

Water safety includes knowing how to handle boats, to swim, to aid swimmers in distress, and to remove your clothing and shoes in the water. Everyone should learn how to swim (*see* Swimming). To avoid the risk of stomach cramps, one should not enter the water until an hour and a half after a meal. Before diving into strange water, swimmers should test it for depth, rocks, and weeds. Stay near shore unless you are an expert. A chilly or tired feeling means that you should leave the water. Foot or leg cramps can usually be cured by rubbing briskly while floating.

Never buck a current or undertow. Swim diagonally *with* a current toward shore; turn and go *with* an undertow, then slant upward and swim to the surface. If thrown into water while dressed, do not try to swim weighed down by clothes. Take time to breathe deeply, duck

under water with your eyes open, and double up so that you can reach to untie your shoes. Then remove trousers or skirt. Most important of all, avoid becoming panicky. Do not try to swim ashore from an overturned boat even if you are a good swimmer. Hold on to the boat and wait for help. (For correct way to handle boats, *see* Boats and Boating; Canoes and Canoeing.)

There would be fewer accidents with firearms if everyone acted on the assumption that "a gun is always loaded." The muzzle should be pointed in a safe direction—away from people and buildings. It should not be pointed at the ground, for a bullet may ricochet. Even with the safety on, a gun should not be pulled muzzle first from a boat or through a fence. The gun should be put through the fence before the hunter climbs through. When a gun is passed to someone, the action should be open to make sure it is empty. Loaded guns should never be taken into a camp or into a house. (For other safety rules in hiking and camping, *see* Camping.)

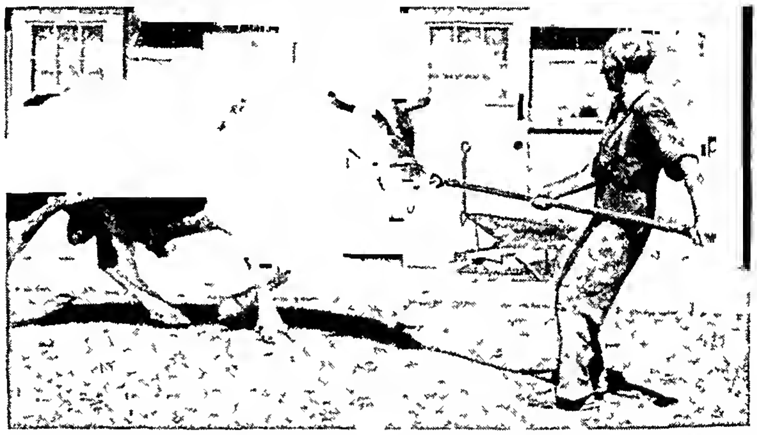
6. SAFETY ON THE FARM

Since the farmer has few safeguards in his varied work, safety habits are even more important to him than to industrial workers. Carelessness is the chief reason why the accident death rate in agriculture is much higher than in manufacturing. Machinery accidents are among the commonest mishaps on a farm. Many of these accidents can be prevented by observing simple precautions, such as never mounting or dismounting from moving tractors or machines.

SAFETY FOR THE FARM AND HOME

To start a saw (above) first guide the flat of the blade with the left thumb. Then move the hand out of harm's way.

When climbing or descending a ladder (right) always face the ladder and hold on to the sides or rungs with both hands.



Attacks by bulls are a common cause of farm injuries. The farmer should always face the animal and lead it by the nose with the aid of a long pole.

Accidents with animals cause many other farm mishaps. Even the gentlest stock should be handled with care. Sharp tones or jerky movements should be avoided. The farmstead should be free of hazards from trash and sharp instruments. Pitchforks, scythes, and all pointed tools should be put away with points downward—not hung from a rafter or tree branch where they can fall or be knocked down.

Lightning hazards can be reduced by equipping all farm buildings with well-grounded lightning rods. Lone trees, fences, and isolated sheds should be avoided in storms, for lightning singles out isolated objects as the most direct route to the ground. If a person is caught in a sudden thunder-storm it is safer for him to stand in the open or to take refuge in thick timber.

When walking on country roads, one should be especially careful, for the hazard to pedestrians is greater in the country than in the city, especially at night. Some of the most important habits to acquire are: (1) walk on the left side facing oncoming cars; (2) step off the road when cars are about to pass close to you; and (3) at night wear something white or carry a light.

REFERENCE-OUTLINE FOR SAFETY EDUCATION

I. The safety problem
   A. Conservation of human resources C-454
   B. Economic loss through accidents S-3, A-512
   C. Reasons for high accident rate S-3, A-513, graphs S-4
II. Growth of the safety movement S-4
   A. Beginnings in industry S-4, I-133: early laws C-249, E-341
   B. Chief measures and agencies of the federal government S-5-6, U-359, H-310, picture U-367
   C. State and municipal measures and agencies S-5, 6, M-450: fire and police departments F-85-91, P-352-6, health service H-308-10, H-300
   D. Safety education in the schools S-4, 8
   E. Private organizations: National Safety Council S-4; Red Cross R-87-8, Boy Scouts B-273-8

F. Safety engineering profession S-6
G. Insurance I-168*a-b*, 169

III. Safety in industry
   A. Legislation and its enforcement S-4, 5-6: factory and labor laws F-10, L-74, C-249; employers' liability E-341; factory inspection H-308; federal bureaus S-5-6
   B. Safety devices S-7: brakes B-284-5; electric fuses A-173; fireproofing F-92; in mines C-367-8, D-23, picture C-369; elevators E-328

IV. Safety on the farm S-12

V. Safety in transportation and traffic
   A. Crusade to cut down traffic accidents
      1. Making streets and highways safe S-4-5, A-513, R-158*a*
      2. Driving laws S-5
      3. Educating and testing drivers S-5, A-513
      4. Rules for safe driving S-11, H-304, C-120, A-513
      5. Rules for pedestrians, bicycle riders, and roller skaters S-10-11
   B. Railroads: safety devices R-65, B-284-5: operating control system R-66-7; intersections S-5; government inspection S-5
   C. Safety at sea: lighthouses and lightships L-235-8; lifesaving service L-225-6; Coast Guard C-371-2, I-8; weather forecasts W-82; ship construction S-157-9; navigation N-72-80; gyroscope G-237-8
   D. Safety in the air S-5: weather forecasting W-82; safety devices A-92-5, A-534-5

VI. Safety at home
   A. Home accident toll S-7
   B. Ways to make the home safe S-7-8
      1. Avoiding falls S-7
      2. Food protection, air and ventilation, lighting, plumbing B-346*b*, H-303-6, P-322
      3. Protection against burns, fires, explosions, gases S-7, 8, F-89-91, C-120
      4. Avoiding electrical accidents S-7-8: short circuit E-303
      5. Protection against poisons S-8, F-96, P-340-1
      6. Keeping yards and walks clean S-8
   C. First aid F-94-8

VII. Safety at school
   A. Accident prevention in classroom, gymnasium, vocational shop, and playground S-8, 10
   B. Safety education S-4, 8: learning traffic safety, pictures S-10, 11

VIII. Safety habits for out-of-door sports and recreation
   A. Water safety S-11-12, C-63, S-471-3: canoes C-113-14
   B. Camping C-59-60, 62-3: first aid for snake bites S-208
   C. Firearms S-12

IX. Safeguarding public health
   A. Public Health Service H-308-10, D-4, M-250*b*, M-153, pictures M-156*a*
   B. Pure food laws P-442-3
   C. Sewerage and waterworks S-110, W-71-4
   D. World Health Organization (United Nations agency) H-310, list U-243

X. Safeguards against fire and floods
   A. Fire prevention rules F-89-91: forest fires F-237-8
   B. Flood control F-144-5, M-308, 310, M-325*b*, T-69

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National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass.
National Safety Council, 425 N. Michigan, Chicago 11, Ill.

Among the periodicals which contain valuable safety material are *Today's Health*, *Public Safety*, *Safety Education*.

SAGEBRUSH. Over immense areas of the dry plains in the western United States, clumps of gray-green sagebrush form the principal vegetation. The best known of several species is the common, or bitter, sage. Usually it is a dwarf shrub, but it may grow to be seven feet or more high. A good growth of this plant occurs when the soil is deep, fertile, and free from alkali. Common sage is the state flower of Nevada, the Sagebrush State.

Some kinds are called salt sages, because they grow in alkaline wastelands. Common sage, bud sage, estafiata, and some others make good cattle feed, particularly in winter and early spring. Several species are useful for control of soil erosion.

Sagebrush belongs to the genus *Artemisia*. The genus includes various plants known as wormwood. Scientific name of common sage, *Artemisia tridentata*. Tarragon, used as a seasoning, is a European species, *Artemisia dracunculus*. (For the flavoring herb called sage, *see* Mint.)

SAGINAW, MICH. A site on both banks of the navigable Saginaw River, just a few miles south of Lake Huron's Saginaw Bay, has made the city of Saginaw the biggest trading and industrial center of east central Michigan. The principal crops raised by farmers in the fertile surrounding valley are beans and sugar beets. The city's industries produce a wide variety of goods, including baking equipment, malleable iron, auto parts, measuring devices, graphite, and refined sugar (from beets).

After driving off the Sauk Indians in the 1600's, the Chippewas held the site until they ceded it to the United States in 1819. The first white man's fur-trading post was established here in 1816. The city took form as two rival villages, one on each bank of the river. Settlers came by boat over Lake Huron or by road from Detroit. In 1837 the west bank village was incorporated. During the 1830's and 1840's "lookers" used the villages as bases as they searched out valuable timber tracts. As lumbering increased, steam sawmills sprang up along the river. A rail line to Detroit opened in 1863. Rivalry between the east- and west-bank towns ended in 1889 when the two united as the city of Saginaw.

Lumbering remained the chief industry until the 1890's. Another early industry was the refining of brine, taken from wells, to salt. Nearby coalbeds, mined during the 1890's and the early 1900's, were left idle when better quality coal mined at more distant points became easily available by lake and rail transport. Most of the city's present industries have grown large since 1900.

Of interest is the colorful old Schuck Hotel, where many pioneer relics are displayed. Saginaw has about 225 acres of parks, one of which has a zoo. Saginaw was granted a new city charter in 1936. Its government is the city-manager council type. Population (1950 census), 92,918. (*See also* Michigan.)

SAGO. The sago in puddings travels far to take its place as a dessert on the American dinner table. Some of it comes from two South American plants. Malaya and the East Indies, however, furnish most of the world supply.

Sago is obtained from the starchy soft inner portion of the sago palm. These trees grow to a height of 30 feet or more in low marshy soils. Their strong trunks have a hard outer layer nearly two inches thick. Inside is a spongy portion which contains the starch product. The trees flower only once, when they are about 15 years old, and die after maturing their seed.

To make sago, men cut the trees down just before they are ready to flower, for the production of the fruit exhausts the starch center. The pith is chopped and grated to a powder and mixed with water to extract the starch particles. This is kneaded in water in a sieve or cloth. The water carries off the starch and leaves the woody fiber behind. The starch is then allowed to settle and is dried. When pressed through a sieve it forms fine pearly grains which are the "pearl sago" of commerce. The growers eat it in cakes or soup, as an important article of diet. Sago is rich in carbohydrates (starch and sugar) and is easily digested. A tree may yield 700 pounds of pith.

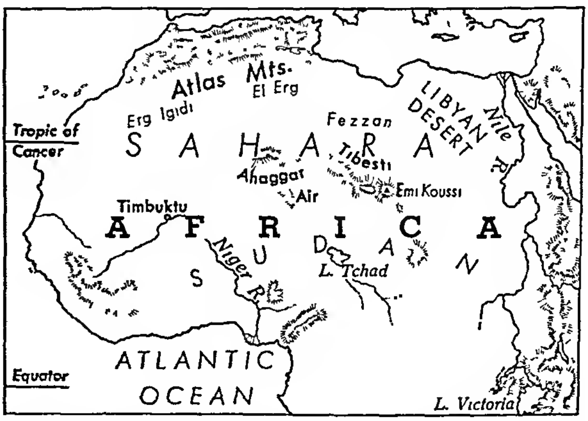
The spineless sago palm *Metroxylon laeve* and the prickly sago palm *Metroxylon rumphii* furnish the bulk of the sago exported to Europe and America.

SAHA'RA. Largest of all the deserts is the Sahara —a vast, sun-baked land of barren rock, gravel, and shifting sand, stretching across northern Africa. A burning sun and scorching winds make it the hottest region in the world in summer. Palm trees and crops can be grown only in patches where springs, wells, or a stream relieve the dryness. These fertile spots are called *oases*.

Extent and Climate of the Sahara

The Sahara gets its name from the Arabic word *sahra*, meaning "desert." Larger than the whole United States it extends some 3,000 miles from the Atlantic Ocean to the Red Sea. Southward it spreads an average of 1,000 miles to the region of the Niger River and Lake Tchad in the Sudan (*see* Sudan). Politically it is not unified. It contains at least a part of the following: French West Africa, Spanish West

SAHARA—LARGEST OF THE DESERTS



The Sahara spreads over an area in North Africa estimated at 3½ million square miles. It extends southward from the Atlas Mountains and the Mediterranean coast to the steppes of the Sudan.

A SAHARAN ERG AND ITS BILLOWING SAND DUNES

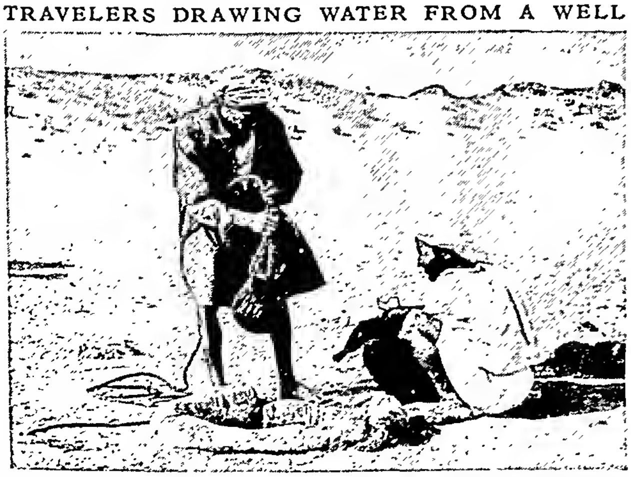
Here two Saharan nomads and their camel are resting. Notice the long robes with hoods. They can wrap these garments about them to keep out the blowing sand. Travelers usually avoid dunes regions. Rock and graveled areas offer better footing.

Africa, Algeria, Libya, Egypt, Sudan, and French Equatorial Africa (*see* Africa).

The Sahara is one of the earth's low latitude deserts that extend inland from west coasts in and near the tropics (*see* Deserts). The dry winds that blow over the hot land seldom drop rain except where mountains force the air upward, cooling it. Elsewhere rain falls only when a powerful cyclonic storm invades the region, bringing a heavy downpour. In some areas, such storms may occur only once in ten or more years.

The normally cloudless sky and clear, dry air expose the land to the piercing rays of the tropical sun. An open, sandy surface may have a temperature of 170° F. or more. In July the average temperature is more than 100° in many places. The land cools rapidly when the sun sets. Temperatures may drop 30 to 50 degrees. In winter the thermometer may fall below freezing in the northern part of the Sahara, and ice may form at night.

TRAVELERS DRAWING WATER FROM A WELL



Nomads and caravan drivers plan their journeys to reach a well before their water supply runs out. The rim around the well mouth was built in an attempt to keep out the blowing sand.

During the hot days, the wind raises little whirlwinds of dust, called "waltzing jinns." At times a furious, dust-laden wind, called the *sirocco*, the *simoon*, or the *harmattan*, sweeps the land. When it comes men and animals must find shelter or perish.

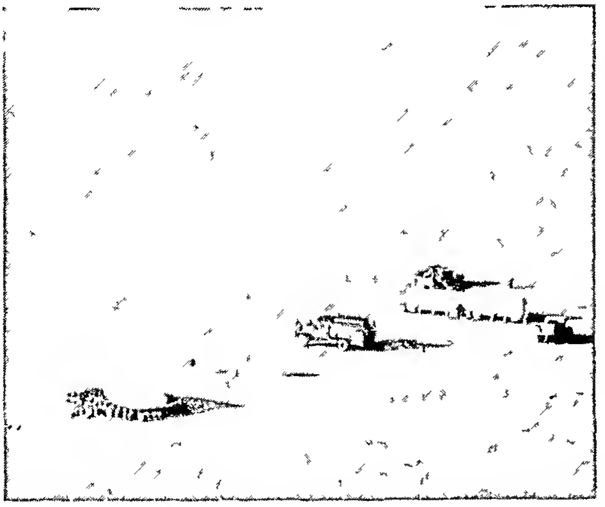
Mountains and Surface Features

Much of the Sahara consists of a series of tablelands, or plateaus, averaging 1,000 feet in altitude. Across it from southeast to northwest runs a broad, rocky ridge. This chain reaches its greatest general elevation in the central Sahara, forming the Ahaggar Mountain mass. The highest mountains rise in the small Tibesti range to the eastward. Many peaks are extinct volcanoes. One cone, Emi Koussi, is 11,201 feet high.

In the Sahara are various surface formations described in the Deserts article—rocky uplands, called *hammadas*, broad stretches of gravel, and basins filled with drifting sand dunes, called *ergs*. Though the dunes are the most picturesque feature, they occupy only about one eighth of the area. Travel routes avoid the sand-filled ergs. The Libyan Erg near Egypt holds the greatest mass of dunes on earth. It covers an area as large as France. The hot sand may give rise to the scorching Egyptian *khamsin* wind. Two other huge sandy deserts are Igidi Erg in the west and El Erg southeast of the Atlas Mountains.

The Nile and the Niger rivers cross the edges of the Sahara, but there are no other permanent streams. Dry stream beds, called *wadies*, seam the desert. They may fill with torrents of water during the rare desert downpours so travelers are warned against camping in them. Some wadies mark the course of underground streams, draining from the mountains. Vegetation fringes these courses where the water table is near enough to the surface to be reached by plant roots. An oasis develops where the water supply is sufficient to irrigate crops. Numerous wells and springs tap the underground water.

A DESERT FILLING STATION



Two trucks and a bus have stopped at a filling station in the western Sahara. They have no road, but simply cross the gravel waste following a trail which camel caravans have taken through the centuries, from water hole to water hole.

In the northwestern Sahara, at the base of the Atlas Mountains, runs a narrow strip of green oases. This "Street of Palms" extends southeast 750 miles to the foothills of the Ahaggar. Another large well-supplied depression, called the Fezzan, lies between the Ahaggar and Tibesti ranges.

Plants and Animals of the Desert

Despite its dryness, the Sahara has scattered plant and animal life. Plants and bushes suited to resist evaporation send their long roots toward underground water, and coarse grass grows in widely separated bunches. After the rare rains, a carpet of delicate, quick-blooming flowers is spread.

Though the vegetation is scanty, animals seek it eagerly. One Sahara dweller is the addax, or desert antelope. It carries a reserve of water in a special sac within its body. Bright-colored lizards lie half buried in the sand. (*See also* Plant Life, subhead "Meeting Special Problems"; Animals, subhead "Securing and Saving Water.")

Historic and Prehistoric Past

The Sahara was not always a parched desert as it is today. Throughout the Ice Age, the huge glaciers and ice caps of Europe pushed the zone of temperate climate southward. Prevailing westerly winds swept over the Sahara and made it a rich grassland and hunting ground for prehistoric men. Today we find many relics of these men. They include stone tools and rock carvings on sheltered cliffs and walls of caves.

The men of those days may have been the ancestors of the present Berbers of northern Africa. The Berbers are an ancient stock of white men, tall and slender, with dark eyes and dark, wavy hair. Their speech resembles that of ancient Egypt more than it does the Arabic of the Mohammedan conquerors who came in the 7th century (*see* Moors).

Caravans and Outlaws

By early ancient times, the Sahara was dry and hot as it is today. The northern coastal strip supported wild tribesmen who made trouble for their civilized neighbors. The Libyan Desert sent raiders into Egypt. The Carthaginians, and later the Romans, had to keep a watchful eye on the Numidians. These fierce horsemen lived inland in what is now Algeria.

The vast desert barred travel to central Africa During the days of the Roman Empire, however, men learned to use the camel for desert travel (*see* Camel). Berbers from the Mediterranean coast filtered southward. They improved irrigation systems and planted date palms. Arabs with long camel caravans crossed the Sahara to collect ivory and gold, skins and ostrich feathers, and black slaves from central Africa. Today many oases are inhabited by Negroes of mixed blood, descendants of early slaves.

The camel provided a perfect mount for the wild Tuaregs, a fanatical tribe of Berbers. The Tuaregs ranged over the desert plundering the little villages and exacting toll from caravans. Only the Tibbu remained unmolested, for they live high in the crags and valleys of the Tibesti Mountains. Another warlike tribe was the Senussi, a Moslem sect of Tripoli. The French desert police have gradually brought law and order to the western Sahara.

How People Live in the Sahara

Only a few people live in the Sahara. Some of them raise crops on irrigated land in an oasis Others tend flocks of goats, sheep, and camels. These herders find grass for the stock along the desert's fringe or where sudden rains have fallen. They live in tents so they can move easily as soon as the grass is eaten in one place. When they move they use camels to carry their household goods (*see* Nomads).

The nomads wear long woolen robes called *barracans* for protection against the hot sun and stinging sand storms. They wear turbans wound around the head and neck and sandals to guard their feet on the hot ground. Water is so scarce and precious, they rarely use any to take a bath. They eat dates from oasis palms and cheese made from the milk of goats and camels. Nomads get most of their supplies from markets in the oasis villages. They trade wool, hides, and some of their animals for dates, coffee, and manufactured articles.

Camels, Cars, and Airplanes

Through the centuries palm-shaded oases have been a port of call for thirsty caravans. Here they made long stops to pasture their camels and break their long, tiresome journeys. Many of the oases grew into little fortified villages. The more important ones have a citylike appearance, with narrow, roofed-over streets, and buildings several stories high. With the coming of the automobile, gasoline stations and small hotels were built.

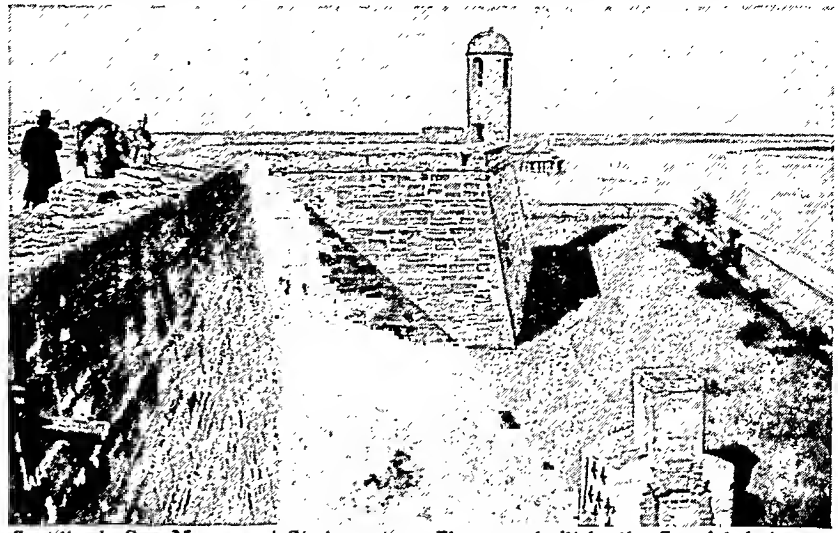
Trucks and buses now speed over the tar-covered roads or flat gravel surfaces of the desert, but everywhere in the Sahara the future of transportation belongs to the airplane. Many oases which were once only caravan stops are now linked to the outside world by their landing fields. The population of the Sahara is estimated at 2,000,000.

SAINT AUGUSTINE, FLA. The oldest permanent settlement in the United States is Saint Augustine. It was founded in 1565, 42 years before the first English settlement at Jamestown.

St. Augustine is situated on a narrow peninsula on the east coast of Florida. Across the bay from the city is Anastasia Island. For many years it has supplied St. Augustine with the building stone *coquina*—a natural rock of tiny shells cemented together.

Present-day St. Augustine retains many features of its long and colorful past. The old part of town spreads out from the broad, shady Plaza de la Constitucion (Place of the Constitution). Old Spanish houses with iron grilles and overhanging balconies line the narrow streets. Just outside the old city gates the Spanish fortress, Castillo de San Marcos, faces the bay. The weathered fort is now a national monument (*see* National Parks). It was begun in 1672 and completed in 1756. The Spanish kings complained of the cost of its upkeep, saying that the fort must be made of gold ducats rather than stone.

OLDEST FORT IN THE UNITED STATES



Castillo de San Marcos, at St. Augustine, Fla., was built by tbe Spanish between 1672 and 1756. Its coquina (sbell stone) walls are 12 feet thick. At lower rigbt is the small oven wbere shot was heated red bot to set enemy ships afire.

The city has many fine hotels. The most noted is the Ponce de Leon, built by the pioneer Florida promoter, Henry M. Flagler, about 1885. Flagler sent architects abroad to study Spanish architecture for the hotel. He built two other hotels. One is now an office building and the other is occupied by the Lightner Museum of Hobbies.

After driving out the French colonizers, Pedro Menéndez de Avilés established a Spanish settlement here in 1565. During its early years, St. Augustine was attacked time and again by the English. Sir Francis Drake landed and burned the town in 1586. In 1665 it was looted and burned by Capt. John Davis. English expeditions from the Carolinas repeatedly threatened to capture St. Augustine.

The fortified town remained under Spanish rule until 1763, when Spain ceded Florida to England. After 20 years, England returned Florida to Spain. Then in 1821, Spain sold Florida to the United States.

Every year St. Augustine welcomes thousands of visitors. They are attracted by the many interesting historic relics, the fine climate, and excellent bathing beaches. The tourist business is the chief industry. Other large industries are shrimp fisheries and railway-repair shops. Population (1950 census), 13,555.

SAINT-GAUDENS' ADAMS MEMORIAL

This magnificent work was commissioned by Henry Adams for his wife's grave in Rock Creek Cemetery, Washington, D.C. Tbe statue is not named but Adams is said to bave called it 'The Peace of God'. Saint-Gaudens suggested 'The Mystery of the Hereafter'.

SAINT-GAUDENS (*sānt-gō'dĕnz*), AUGUSTUS (1848–1907). A shoemaker's son freed American sculpture from the bonds of tradition. He was Augustus Saint-Gaudens. Before his time, American sculptors had merely followed the style of European artists or had slavishly copied from the ancient Greeks and Romans.

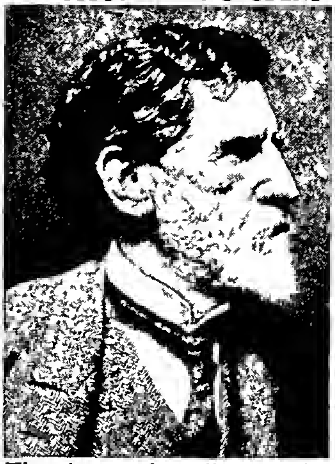
Saint-Gaudens was born in Dublin, Ireland. His mother was Irish and his father French. Six months after his birth, the family came to the United States. They settled in New York, where his father continued his trade as shoemaker. As a boy Augustus spent hours in his father's shop making pen drawings of the workmen. When he was 13, he was apprenticed to a cameo cutter. At night he studied drawing at Cooper Union, then at the National Academy of Design.

When he was 19 his father sent him to Paris. To support himself, Augustus worked as a cameo cutter. He first studied in a medical school where he learned anatomy in modeling. Then he was accepted at the École des Beaux-Arts. In 1870 he went to Rome to study, again cutting cameos. Rome's classical beauty enchanted

him, but his first piece of sculpture recalled the heritage of pioneer America. It was 'Hiawatha', which now stands at Saratoga.

In 1873 he returned to New York and executed several commissions which brought him acclaim. His full-length statue of Admiral Farragut was outstanding. Unveiled in 1881 in Madison Square, its realism marked Saint-Gaudens' break from convention. He taught at the Art Students' League. He was quick to praise his pupils and set them an example by his own industry. "Sculpture," he said, "is hard labor." His friends and students loved him for his unfailing kindness.

AUGUSTUS SAINT-GAUDENS



His vigor and realism revolutionized American sculpture.

In 1885 Saint-Gaudens moved to Cornish, N. H. He called his studio "Aspet," after his father's town in France. He was elected to the Royal Academy in London. When working on a portrait statue, he read widely about his subject so he might glimpse the person's character. His statues seemed to breathe personality. "Life," he said, "is a battle, bitter or friendly ... and to my mind a wholesome one."

Chicago has two works by Saint-Gaudens: 'Lincoln' (1887) in Lincoln Park, and 'General Logan' (1897) in Grant Park. His Garfield Memorial (1895) stands in Fairmont Park, Philadelphia. Boston has the Shaw Memorial (1897). His 'General Sherman' (1903) is in Fifth Avenue Plaza, New York City.

SAINT JOHN, NEW BRUNSWICK. When ice has closed all the other important seaports of Canada except those of the Maritime Provinces, the great harbor of Saint John is always open. It lies at the mouth of the St. John River on the Bay of Fundy. The bay's great tides, about 25 feet high at this point, mingle with the waters of the river, and so prevent the formation of ice. This advantage, combined with the short railway haul from the interior, serves to strengthen the city's position as one of the chief winter ports of Canada. It is the Atlantic terminal of the Canadian Pacific Railway and is also one of the terminals of the Canadian National Railways, which bring the grain and other products of upper and western Canada for winter shipment.

One of St. John's attractions is the natural wonder of the reversing falls in the St. John River. When the tide is out, the falls flow toward the sea. At half tide or slack water they are open to navigation both ways. At high water or full tide the current flows inward, hence its title of Reversing Falls.

Grain elevators, a large sugar refinery, cotton mills, iron and brass foundries, flour and rolling mills, saw and wood-pulp mills, woodworking factories, and other industrial establishments make Saint John one of the chief manufacturing centers of the Maritime Provinces. It was the first city in Canada to adopt the commission form of government. The name of the city and river comes from the fact that Champlain landed here in 1604 on the feast day of St. John the Baptist. It has been an important city since 1783-84, when it received an immigration of more than 9,000 loyalists from the American Colonies, fleeing the Revolution. Population (1951 census) 50,779.

ST. LAURENT (*săṅ lô raṅ*), **LOUIS STEPHEN** (born 1882). In just seven years Louis St. Laurent arose from political obscurity to the leadership of Canada. He had never held public office until December 1941. Yet on Nov. 15, 1948, he became prime minister. He was the second French Canadian to achieve that high post.

He was born in Compton, Quebec, Feb. 1, 1882, the son of a French-Canadian father and an Irish mother. His father was a storekeeper. As a child he spoke only French to his father and only English to his mother. He studied law at Laval University, where he later taught. He became an outstanding corporation lawyer. In 1908 he married Jeanne Renault of Quebec City. They had two sons and three daughters.

In 1941 the death of Ernest Lapointe had left the cabinet and the Liberal party without a French-Canadian leader from Quebec. Mackenzie King, then prime minister, asked St. Laurent to fill the cabinet post of minister of justice. In Canada all cabinet ministers must be members of Parliament. St. Laurent ran for election from eastern Quebec. He won a large majority in spite of his support of national military conscription. As minister of justice he won distinction by his investigation of a Communist spy ring which reportedly had knowledge of atomic energy research.

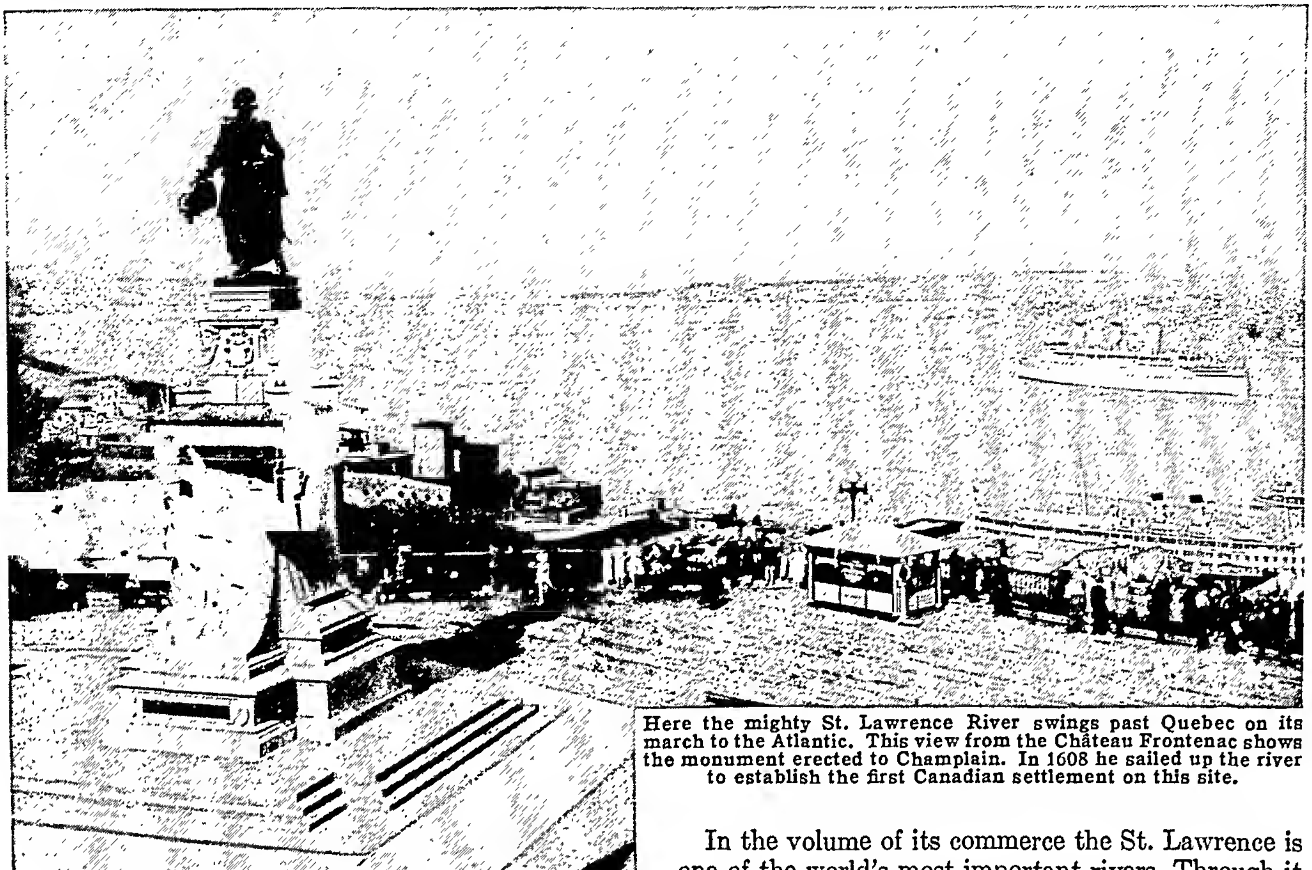
LOUIS ST. LAURENT

He was the second French Canadian to become premier of Canada.

In 1946 Mackenzie King turned over to St. Laurent his own post as secretary of state for external affairs. St. Laurent attended the sessions of the United Nations General Assembly and worked to strengthen its organization. He became convinced that a military alliance was the only way to insure peace. As a result, Canada in 1949 joined the North Atlantic Pact.

St. Laurent was chosen by the Liberal party to become its leader in August 1948. Three months later he succeeded Mackenzie King as prime minister. St. Laurent advocated economic coordination with the United States and completion of the Great Lakes-St. Lawrence River power and seaway plan. To speed lawmaking in Canada, he persuaded the provinces in 1950 to study ways to amend the Canadian constitution.

The SAINT LAWRENCE—HIGHWAY *to the* SEA



Here the mighty St. Lawrence River swings past Quebec on its march to the Atlantic. This view from the Château Frontenac shows the monument erected to Champlain. In 1608 he sailed up the river to establish the first Canadian settlement on this site.

SAINT LAWRENCE RIVER. French explorers found the St. Lawrence River an invitation into the heart of North America. While the English colonists, hemmed in by the Appalachian Mountains, still hugged the coast, the French traveled up the St. Lawrence, entered the Great Lakes that feed it, and made their way to the Mississippi Valley.

Jacques Cartier, commissioned by the king of France to explore the American coast, discovered the river on his second voyage in 1535 (*see* Cartier). He named it the St. Lawrence to honor the saint on whose feast day, August 10, he arrived at the entrance. In 1608, twelve years before the landing of the Pilgrims at Plymouth Rock, Champlain established a permanent settlement at Quebec (*see* Champlain). During the following century, LaSalle, Marquette, and Joliet explored the Mississippi River valley, giving France claim to hundreds of thousands of square miles in the New World.

The St. Lawrence is swollen by the waters of many lakes, rivers, and streams. If you trace it back to its ultimate source, the quest leads you through the Great Lakes to the far end of Lake Superior, then up the St. Louis River into Minnesota. But what is actually called the St. Lawrence is a comparatively short stream—about 740 miles from its beginning at the east end of Lake Ontario to Cape Gaspé. From this point on the river becomes the Gulf of St. Lawrence, which is about 430 miles long.

In the volume of its commerce the St. Lawrence is one of the world's most important rivers. Through it pass huge shipments of grain that start their journey at the western extremity of Lake Superior, 2,350 miles from the ocean. Petroleum products from the south end of Lake Michigan travel 2,270 miles to the Atlantic. The river also carries lumber, wood pulp, and minerals from the Canadian interior and many products from the manufacturing regions of the midwestern United States.

The Varied Course of the River

On the Canadian shore of Lake Ontario, where the river leaves the lake, lies Kingston, an important grain-transferring port. A little farther along the river widens into a lake, studded with the scenic Thousand Islands. Here it passes under the Thousand Islands Bridge.

It is all clear sailing between Kingston and Prescott, a distance of 64 miles. But along the 119-mile stretch between Prescott and Montreal the river falls 223 feet through a succession of rapids. First come the Galop and the Long Sault rapids between Prescott and Cornwall, Ontario. Next comes a 31-mile stretch of calm water through Lake St. Francis, followed by the Soulanges Rapids leading into Lake St. Louis, 16 miles long. Finally, between Lake St. Louis and Montreal Harbor stretch the Lachine Rapids—49 miles of rapids in all.

Skillful pilots can manage to take passenger vessels down these rapids, but most vessels use the nine canals which have been built around the rapids. The canals accommodate vessels drawing up to 14 feet

of water. Westbound caigoes of larger vessels must be transshipped at Montreal.

The average width of the river between the Thousand Islands and Quebec is a little less than two miles. Sometimes it narrows to a mile or broadens into a small lake. It is about ten miles wide when it sweeps past the Isle of Orleans and it broadens to a width of more than 90 miles at Anticosti Island at the entrance to the Gulf of St. Lawrence.

At Montreal, the Ottawa River enters the St. Lawrence from the northwest. At the junction it divides into two foiks, between which lies the island on which the city is built (*see* Montreal). Between Montieal and Quebec the banks of the St. Lawience aie low and fertile. Here agriculture is piactised extensively.

Where the Angelus Still Peals

East of Quebec the St. Lawrence passes through the rocky and forest-clad Laurentian Plateau, where good farming land is scarce (*see* Laurentian Plateau). Numberless small streams tumble off the plateau into the St. Lawrence. Some of them have been harnessed for electricity. But aside from a few industrial centers, and the areas deforested for lumber and pulpwood, the country has remained virtually unchanged through the centuries.

Here the river flows through endless forests of white pine, northein spruce, fir, hemlock, tamarack, birch, poplar, ash, maple, and elm. Lazy roads wind through the woods to French-Canadian villages where the spinning wheel still hums and the Angelus still peals across the land and the river. Summer days are long in this northern country, and the warmer weather brings the clap and flutter of birds' wings—bank swallows skimming the water, gray gulls, white terns, black cormorants, blue herons, and great unblinking white owls. Among the beasts that leave their tracks along the banks are the bear, the moose, and the wolf. The sturgeon and the eel are the most abundant of edible fish.

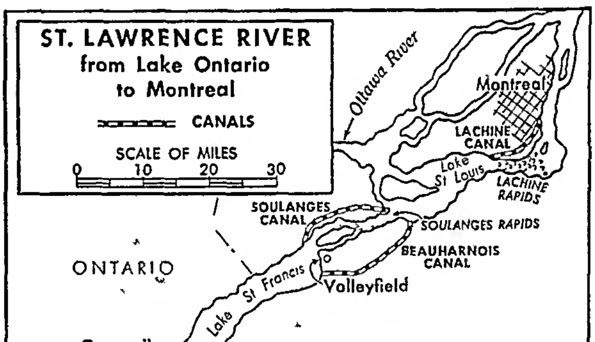
Along the north bank, toward the mouth of the St. Lawrence, Indians live much as they did in the days of Frontenac. Here and there the shore shows their little villages of unpainted shacks, a church, a store or two, and a fur-trading post. A boat may arrive once a month when the season is open.

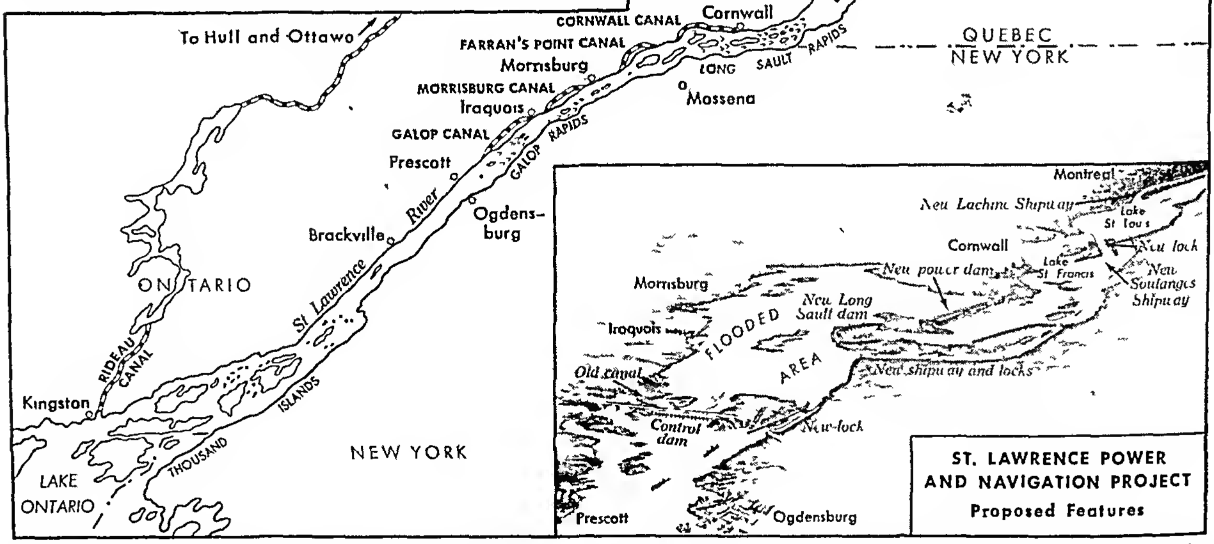
The St. Lawrence Seaway Project

To make the St. Lawrence navigable for large ships from the sea to the Great Lakes, the St. Lawrence Seaway Project contemplates increasing the minimum depth of all channels to 27 feet. Most of the work would have to be done in the area of the rapids between Prescott and Montreal.

The project calls for building a dam at the Long Sault Rapids to extend from the upper end of Barnhart Island to the United States mainland. From the lower end of the island, a great powerhouse structure would stretch across the river to the Canadian bank. Here it is planned to use the 92-foot drop in water level to generate electricity. New locks would pass ships around the main dam.

The dam between Lake St. Francis and Lake St. Louis now produces power for the Beauharnois hydroelectric plant. This dam impounds sufficient water to provide a navigable channel around the Soulanges Rapids. A seiies of thiee new locks would permit ships to navigate the 83-foot drop in water level.





No ship can navigate the upper reaches of the St. Lawrence River because of the many rapids there. And though canals and locks by-pass the rapids, they will not accommodate vessels of deep draft. But if proposed improvements are carried through, ocean-going vessels may ply between Great Lakes cities, which tap the interior resources of the continent and the seaports of the world.

Between Lake St. Louis and Montreal Harbor, the river drops 48 feet. About ten miles of canals and three locks would be needed at this point to pass ships around the Lachine Rapids. Beyond Montreal, the natural river channel is deep enough for ocean-going vessels without building dams or locks.

The estimated cost of about 600 million dollars would be divided between the United States and Canada. The planned hydroelectric installations could produce about 2,200,000 horsepower, or about 13 billion kilowatt-hours, a year. Ontario and New York State would share this power.

The United States and Canada reached an agreement on the seaway project in 1941. The Canadian Parliament approved the plan at once and the United States Congress finally passed its bill in 1954.

Historic ST. LOUIS—*Its* COMMERCE *and* CULTURE

This view by Fairchild Aerial Surveys shows downtown St. Louis, with the Mississippi River in the background spanned by the Municipal Bridge on the right and the Eads Bridge on the left. Notice the six blocks which comprise the Memorial Plaza in the very heart of the city.

SAINT LOUIS (*lo̤′ĭs*), Mo. On Feb. 15, 1764, Pierre Laclede, a very early French trader from New Orleans, established a post on the Mississippi River to promote fur trade with the Indians to the northwest. The settlement lay on the west side of the "Father of Waters," a few miles below the mouth of the Missouri River. The Illinois River, about 30 miles to the north, was the highway to the Great Lakes region. And downstream some 125 miles was the mouth of the Ohio River, leading far toward the East. The location was a natural focus for the trade of the entire Middle West. Out of the little log fort with its cluster of dwellings has grown St. Louis—the largest city in Missouri and one of the nation's leading industrial and commercial centers.

The Role of Transportation in Its Development

In this growth, transportation played an important part. The city was the great river port of the Central Plains in the middle 19th century. Most of its trade was carried on by boat, and the levees were the busiest part of the city. River traffic declined after 1850, but the railroads brought still more business to the already thriving city. Today it is second only to Chicago as a rail center in the United States.

Seven bridges cross the Mississippi River to St. Louis. One is used exclusively by the railroads. Three are combined railroad and highway bridges, and three accommodate only vehicular traffic. Eads Bridge, completed in 1874, was one of the great engineering triumphs of its day. It was designed and built by a St. Louis engineer, James B. Eads.

With the revival of river transportation in recent years the city has resumed its old position as a port. Fleets of steel barges ply south to New Orleans, north to St. Paul, to Chicago by way of the Illinois Waterway, and up the Missouri River to Kansas City. Lam-

bert Field, the municipal airport, handles a growing air traffic. The city's "air conscious" businessmen financed Charles Lindbergh's flight to Paris in 1927 in the *Spirit of St. Louis.*

Industrial Giant of the Plains

As the surrounding countryside was turned into farms, St. Louis marketed its products and distributed to it the manufactured goods of the East. The city became a horse and mule market. It also built large meat-packing plants which handled increasing numbers of hogs and cattle. With quantities of hides at hand and a growing market, St. Louis early became a leading center for boot and shoe manufacture. It now makes almost one-fourth of the nation's shoes. The fur-trading started by Laclede and his trappers has grown until St. Louis is now an important market for pelts. Other large industries in the city are the manufacture of electrical machinery, automobiles and automobile equipment, and streetcars.

Power for the city's mills and factories comes from the coal beds of southern Illinois, the Mid-Continent oil fields, and the hydroelectric plants at Keokuk, Iowa, and Bagnell, Mo. In 1939–40 the city established highly successful smoke-elimination measures.

The New City and the Old

The city extends along the river for about 20 miles, and westward for almost 10 miles over rolling uplands which rise to a maximum height of 900 feet above sea level. Streams flowing into the Mississippi have cut valleys which provide natural routes for the railroads. Factories and warehouses have grown up beside the railroads in the valley bottoms, and the retail and residential districts occupy the upper levels. East St. Louis, just across the river in Illinois, is closely associated with the Missouri city. The corporate limits of St. Louis were set by the Missouri legislature in 1876 at 61.4 square miles. The city's influence, however, extends throughout its metropolitan area of more than 800 square miles.

The old French town, known as Laclede's Village, extended along the river front between the present Municipal and Eads bridges. In this little village the vast territory of Upper Louisiana was formally transferred from France to the United States in 1804. On the site of the first log church is a magnificent cathedral, consecrated in 1834. Very near it is the courthouse in which the famous Dred Scott trial was held. From the stone auction block at the east door slaves were sold before the Civil War. On the river front stands Old Rock House, the oldest building in the city. Forty square blocks, occupying the site of the original village, have been purchased by the United States National Park Service for the Thomas Jefferson Expansion Memorial. All buildings save the historic old structures have been demolished, and the area is being made into a park with a monument to Jefferson and the Louisiana Purchase.

The Civic Center and the Parks

On the bluffs above the river front is the business district. A civic improvement plan, adopted in 1923, has remade this part of the city at a cost of more than $100,000,000. About $25,000,000 was spent in widening some 50 miles of streets. A Memorial Plaza covering six blocks is the center around which are grouped many fine public buildings, including the City Hall, Civil Courts Building, Municipal Auditorium, and the Soldier's Memorial. North of the Plaza is the Public Library, designed by Cass Gilbert.

West of this Civic Center stands the Union Station. Facing it is a broad plaza created by razing blocks of drab tenements. The plaza has a beautiful fountain, 'The Meeting of the Waters', designed by the sculptor Carl Milles. Eugene Field's boyhood home, near Ead's Bridge, is owned by the city.

Forest Park, covering about 1,400 acres, is west of the business district. The Louisiana Purchase Exposition of 1904 was held here. In the park is the Jefferson Memorial Building, which contains the original documents of the Louisiana Purchase; the original papers of the Lewis and Clark Expedition, which started from St. Louis; the trophies given to Charles Lindbergh after his flight to Paris; and relics from the Indian mounds of the region which gave St. Louis the nickname "the Mound City." The Zoölogical Park was among the earliest of the cageless type in the United States. In Forest Park are also the Art Museum; an outdoor municipal theater for summer opera, which seats about 12,000; the Jewel Box, a conservatory of modernistic design; and the statue of St. Louis, symbol of the city. Southeast of Forest Park, adjoining Tower Grove Park, is the Missouri Botanical Garden, popularly known as Shaw's Garden. It has one of the largest and most notable collections in the world.

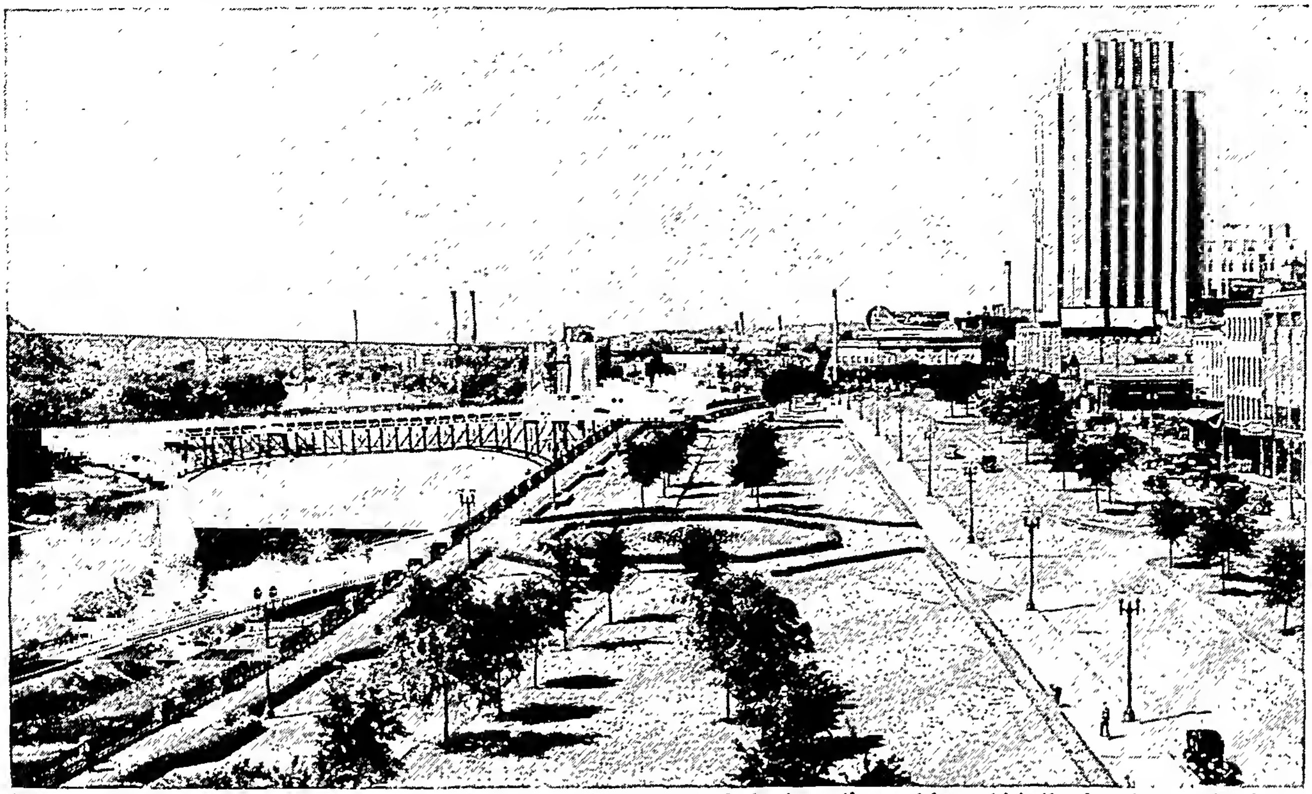
St. Louis has a unique annual celebration called the Festival of the Veiled Prophet of Khorassan, which was first held in 1878. It is given in mid-October. A mysterious "prophet" rules with his "queen," "court," and "order of knights," over a two-day carnival, a parade, and final ball. His identity is never known.

History, Culture, and Education

St. Louis was named for the patron saint of Louis XV, of France. From 1770 to 1800 the city was the capital of the Spanish territory of Upper Louisiana. After the Louisiana Purchase the West was opened to settlement, and St. Louis grew rapidly. It was incorporated in 1822. German immigrants came in large numbers in the first half of the 19th century. They sponsored a symphony orchestra and other musical societies and helped to establish in St. Louis in 1873 the first public kindergarten in the United States. Educational institutions in the city are St. Louis University (Jesuit), including Maryville College of the Sacred Heart; Washington University; and Concordia Theological Seminary (Evangelical Lutheran). Population (1950 census), 856,796.

Saint-Mihiel (*săn-mē-yĕl′*), **France.** In the summer of 1918, the Allied armies began to beat back the Germans, and the commander in chief, Marshal Foch decided upon a huge attack against the northern and southern flanks of the main German positions. The southern attack was entrusted to the American forces under General Pershing.

ST. PAUL'S BUSINESS DISTRICT ALONG THE MISSISSIPPI RIVER



Here Kellogg Boulevard, St. Paul's broad and attractively landscaped main business thoroughfare, skirts the downtown water front: The towering skyscraper on the right is the City Hall and County Courthouse. The wooded land on the left is Raspberry Island. All along this boulevard vistas of the river enhance the beauty of the city.

Their task was to paralyze the central portion of the German armies by seizing the vital rail and supply centers at Sedan and Metz. To do this, however, called for enormous strength in men and great quantities of ammunition, food, and supplies, and the Germans were in a position to cripple the movement of supplies. Ever since 1914, they had dominated the main railroad lines from France into Metz, and into Verdun in the north, from a wedge-shaped salient with its tip at Saint-Mihiel on the Meuse River. The Americans had to free these supply lines for their use before they could deliver their main attack.

To do this, General Pershing formed the American First Army under his command on Aug. 19, 1918. On the night of September 11, 500,000 men, including 70,000 French colonial troops, were ready to attack at daylight. After four hours of artillery bombardment, the infantry and tanks went over the top, and within a day they completed their task. (For map and details of the action, *see* World War, First.)

The operation captured some 16,000 prisoners and 443 guns, at a cost of about 7,000 Americans killed and wounded. With the supply lines freed, the Americans were able to begin the decisive battle of the Meuse-Argonne on September 26 (*see* Meuse-Argonne).

SAINT PAUL, MINN. At the head of navigation on the Mississippi River is Minnesota's capital and second largest city. St. Paul lies on both sides of the river, which here makes a double curve like a letter S tipped over on its face. On the west St. Paul adjoins its larger "twin city," Minneapolis.

St. Paul grew up around Fort Snelling, which was established in 1819 to protect the headquarters of the American Fur Company. Its site, where the Minnesota River flows into the Mississippi, had been selected in 1805 by Zebulon M. Pike, explorer and army officer, who recognized its military importance as a gateway to the Northwest. Pig's Eye, the nickname of its first settler, the trader Pierre Parrant, was also the popular name for the settlement until Father Lucien Galtier renamed it St. Paul upon building the first church in 1841.

The early prosperity of the city and of the entire Northwest was due in large part to the dynamic James J. Hill, railroad and empire builder, who came to St. Paul as a young man in 1856 (*see* Hill). With the coming of railroads St. Paul grew rapidly as a distributing center. By 1870 it had some of the largest wholesale and jobbing houses in the country. In recent years traffic on the Mississippi has revived with the construction of government dams and locks to ensure a nine-foot channel.

The business section and much of the residential area of the city lie on the north bank of the river, where the bluffs are lower and less abrupt than on the south bank. Third Street, the main business thoroughfare paralleling the river, has been transformed into a broad plaza and parkway named Kellogg Boulevard for the statesman Frank B. Kellogg, long a resident of St. Paul. On this boulevard are the City Hall and County Courthouse. The Fourth Street lobby of the building is known as the War Memorial Concourse.

Its most interesting feature is an onyx statue of the Indian god of peace by Carl Milles, Swedish-American sculptor. Also on Fourth Street are the imposing Public Library and the James Jerome Hill Reference Library, housed in the same building.

St. Paul's varied manufactures include food products, beverages, refrigerators, hoists and derricks, abrasives, telephone equipment, paper and boxes, plastics, and cosmetics. It is the home of an airline, a large storage-battery firm, and important lumber and lumber-products companies. It has a large automobile-assembly plant and railroad-repair shops. Another big industry is printing, including advertising specialties. The stockyards and packing houses of South St. Paul, a suburb, are among the largest in the nation.

The State Capitol and Other Features

The State Capitol, on a hill northwest of the river, was designed by the famous architect Cass Gilbert, who grew up in St. Paul. Sculptures and murals by the nation's foremost artists adorn it (for picture, *see* Minnesota). Near the Capitol are the State Office Building, the Minnesota Historical Society, and the St. Paul Institute (a museum of science).

Two lakes within the city limits and the wooded bluffs on both sides of the Mississippi afford attractive settings for parks and boulevards. On Summit Avenue, one of the finest residential streets, is the St. Paul Cathedral. Holman Municipal Airport is within five minutes' driving distance of the business district. Good air, rail, and bus transportation, fine hotels, and the great municipal auditorium attract many conventions to the city. The State Fair every fall and the annual Winter Carnival bring thousands of visitors.

In St. Paul are the University of Minnesota's College of Agriculture; Hamline University (Methodist); Macalester College (Presbyterian); Concordia College (Lutheran); and the College of St. Catherine and the College of St. Thomas (both Roman Catholic).

The city was incorporated in 1854 and became the state capital in 1858. It has the commission form of government. Population (1950 census), 311,349.

SAINT PETERSBURG, FLA. One of St. Petersburg's daily papers boasts of the city's many cloud-free days by giving away its papers on any day that the sun does not shine before 3:00 P.M. The city is a favorite winter vacation spot for older people; it calls itself the "sunshine city."

St. Petersburg occupies the lower part of the Pinellas peninsula, halfway down Florida's west coast. On its east is Tampa Bay and on its west, Boca Ciega Bay. Fine bathing beaches line the shores of both bays, and many vacationers journey over the causeways to bathe on the gulf side of the sandspits that form the western boundary of Boca Ciega Bay. A long bridge connects St. Petersburg with Tampa. Much of the city's Tampa Bay frontage has been filled in and made into parks. The more than half-mile-long recreational Municipal Pier and the city's airport extend into the bay from this shore. Other attractions are the spring training fields of the New York Yankees and the St. Louis Cardinals.

The city's wide Central Avenue crosses the peninsula from east to west; it is the dividing line for north and south street numbers. Along its busiest section the sidewalks are crowded with green benches. On these the oldsters group for talk of the weather, crops, politics, and such matters. The city's many parks have facilities for shuttlecock, tennis, softball, roque, lawn bowls, and other games.

Before St. Petersburg was founded, the peninsula had only a few scattered farms and fishermen's huts. In 1876 John C. Williams, of Detroit, Mich., bought the acreage that is now the center of the city. After attempting to farm the land, he decided to subdivide it. He was aided by a Russian exile who named the settlement for the czarist capital. A rail line connecting with northern points reached the community in 1888. The town was incorporated with a population of 300 in 1892. The peninsula to the north developed as citrus-growing land.

St. Petersburg's growth as a winter resort began about 1911. It established a promotion campaign that continues to this day. By 1925 its population had grown to 50,000. During the winter it welcomes several times this number of vacationers. St. Petersburg has a junior college; its government is the city-manager form. The city owns the transportation system. (*See also* Florida.) Population (1950 census), 96,738.

SAINT VALENTINE'S DAY. For centuries February 14 has been observed as Saint Valentine's Day. Chaucer and other medieval writers speak of it as the day when the birds mated. In Shakespeare's 'Hamlet' one of Ophelia's songs is:

> Tomorrow is Saint Valentine's day
> All in the morning betime,
> And I a maid at your window,
> To be your Valentine.

Traditionally, February 14 is a day for lovers. In medieval times young people in England, Scotland, and France used to assemble on Saint Valentine's Eve. Each person became the "valentine," or the special friend, of the one whose name he drew. It is still customary on this date to exchange gifts, many of them heart-shaped, as an expression of affection. Friends send cards, flowers, and candy as greetings.

In the United States, schools celebrate the day. The children make and give valentines. Simple and inexpensive valentines can be made from Christmas wrappings, paper doilies, pictures of flowers in magazines, and from the colored linings of used envelopes. Just as in medieval times, all the greetings are often placed in a valentine box.

Of the several saints named Valentine, the most important were a Roman priest and a bishop of Terni, both of whom were executed in Rome in the 3d century. That their feast day is also the day set aside for lovers seems to be merely a coincidence. The Roman festival Lupercalia, which occurred on February 15, may be related to the modern celebration.

SAL'ADIN (1138–1198). "Before I saw his face I was sore afraid, but now that I have seen him I know that he will do me no harm." These are the words of a Crusader who was taken prisoner and brought before Saladin, sultan of Egypt and Syria, the noblest foe that the knights of the Cross ever encountered. By the Mohammedans he was revered as a wise ruler, a leader who was able to unite his people and turn back the tide of Christian invasion, and as a man who embodied the highest virtues and ideals of Islam.

His leadership came at a time when the Mohammedan world, without political unity, was sinking into decay. Bit by bit, since the First Crusade had won Jerusalem for Christendom, the empire of the Seljuk Turks, who held the temporal power of Islam, had been falling apart. It was not the strength and zeal of the Christians so much as the weakness of their foes that had kept the Christian Kingdom of Jerusalem alive.

The name of this leader was Yusuf ibn Ayyub, and Salah-ed-din (or Saladin) is merely the title given him, meaning "Honor of the Faith." He came of that strong and warlike race of Asia Minor, the Kurds. His father was governor, under the Seljuk Turks, of the province of Tekrit in Armenia. Saladin himself rose to prominence early. He was sent by Nurredin, the Seljuk sultan of Syria, on an expedition to Egypt. This resulted in the winning of that land for Nurredin and eventually in the appointment of Saladin as vizier of Egypt. When Nurredin died rebellion broke out against his young heir, and Saladin, seizing the opportunity, overran and gained control of Syria. The caliph of Egypt had also died, and Saladin was now the most powerful ruler in Islam. The caliph of Baghdad recognized him as the sultan of both Egypt and Syria.

Saladin's great purpose was to win back for Islam the lands embraced in the Kingdom of Jerusalem. When in 1187 one of the Christian leaders broke faith, he seized the opportunity to proclaim a Holy War. Gathering forces from all parts of Egypt, Syria, and Mesopotamia, he overran Palestine. Jerusalem was besieged and captured (1187), and the entire Christian kingdom, except Tyre, was conquered. In his taking of Jerusalem, as in all his acts, Saladin showed himself chivalrous and merciful. There was no such slaughter of nonresisting inhabitants as had marked the taking of the city by the Crusaders almost a century before. The captives were set free on payment of ransom, and many of those who were too poor to pay were given their freedom through charity.

To regain Jerusalem the Third Crusade was undertaken by the Christian rulers of Europe, notably Philip Augustus of France and Richard I of England. The struggle ended with Jerusalem and all Syria, except the coast line, in the hands of Saladin. The treaty of peace signed in 1192, however, provided that Christian pilgrims might freely visit the Holy Sepulcher at Jerusalem.

Saladin was a favorite figure in medieval romance. Sir Walter Scott in 'The Talisman' has given us a noble picture of his chivalry and faithfulness to his word, shown particularly in his dealings with his great adversary, Richard the Lion-Hearted.

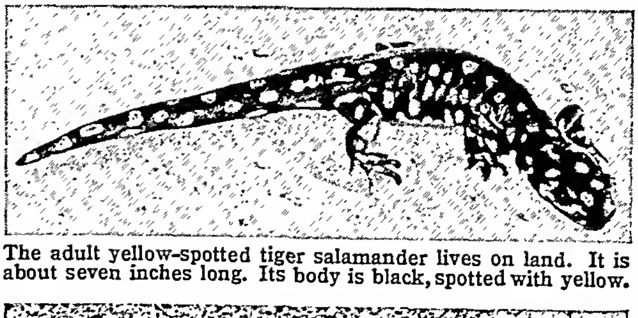
SAL'AMANDER. Like their cousins, the frogs and the toads, salamanders are equally at home on land and in the water. All three animals belong to the class known as *Amphibia*. Salamanders have tails and are shaped so much like lizards that they are often mistaken for them. Both are egg-laying, cold-blooded, backboned animals. The differences, however, are easily observed. Lizards are covered with dry scales and have claws on the toes of their feet. Salamanders have smooth, moist skin and no claws. They absorb water and air through the skin as well as through the lungs or gills.

Far from being able to live in fire, as the ancients supposed, salamanders shrivel and die if their skin dries out. On land they always seek damp, shady places. In very dry seasons some species of salamanders burrow into the ground until the rains return. In cold climates they hibernate. The land-dwelling kinds find shelter in rotting logs or under the surface cover of the forest floor. The water-dwelling kinds hide under stones in flowing streams.

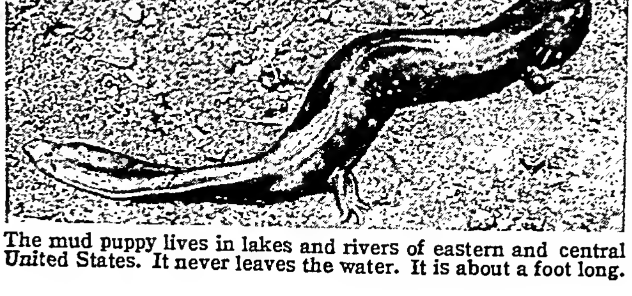
They are timid, harmless creatures, defending themselves by running away or hiding. They feed on worms, insects, snails, and small fish.

Salamanders are scattered over the temperate and tropical regions of the world. They vary in size from small salamanders four inches or less to the giant salamanders of the mountain streams in China and Japan, which reach five feet in length. Mud puppies, hellbenders, newts, and efts are all salamanders. The American species pictured on this page illustrate the striking contrasts between the water-dwelling and the land-dwelling kinds.

TIGER SALAMANDER AND MUD PUPPY



The adult yellow-spotted tiger salamander lives on land. It is about seven inches long. Its body is black, spotted with yellow.



The mud puppy lives in lakes and rivers of eastern and central United States. It never leaves the water. It is about a foot long.

LAND AND WATER STAGES OF THE NEWT

The eft, or red newt, is the land-dwelling stage of the common newt. Its skin is bright orange with two rows of vermilion spots.

In about three years the newt returns to the water. Now it is called the spotted newt. It changes color to olive green.

The common newt, or eft, of America (*Triturus viridescens*) hatches from an egg in the water and stays there during its first summer as a dull green larva. Then its skin becomes a bright orange with two rows of scarlet spots. It absorbs its gills, develops lungs and legs, and crawls out to live for about three years in the woods. In this phase it is called an eft, or *red newt*, and is two or three inches long. When fully matured it goes back to the water to breed. Its back turns dull again and black spots appear on its orange belly. It is now called a *spotted newt* and is about four inches long. The females lay their eggs in jelly-like capsules on the leaves of water plants. In cold weather newts bury themselves in the mud.

The dusky salamander (*Desmognathus fuscus*) reverses this life history. It lays its eggs on land, and the larvae live in moist earth for a few weeks before entering the water. When they are ready to breed they return to the land. This salamander is reddish brown and about six inches long. Although it is a land-based species, it has no lungs, only gills and breathing pores in its skin.

The spotted salamander (*Ambystoma maculatum*) spends its adult life on land, returning to the water to lay its eggs. It has a stout shiny black body with yellow spots and is about six inches long.

The mud puppy, or water dog (*Necturus maculosus*), and the hellbender (*Cryptobranchus alleganiensis*) spend their entire lives in the water, swimming about or crawling on the bottom. The mud puppy is about a foot long and the hellbender about 18 inches.

In the eastern part of North America the tiger salamander (*Ambystoma tigrinum*), after spending its early life in the water, changes to an adult form and lives on land. However, in the dry Southwest, where the land offers no damp refuges, it stays in the water, keeps its gills, and continues in the larval state; yet it grows in size and presently is able to breed like a normal adult. These arrested larvae are called *axolotls*. If removed to damp ground they turn into lung-breathing adults. Tiger salamanders are about seven inches long and have heavy black bodies blotched with yellow.

Salamanders form the order *Caudata*, or tail-bearing group, of the class *Amphibia*.

SAL'AMIS. The great naval battle of Salamis, one of the decisive battles of the world, was fought between the Greeks and Persians in 480 B.C., in the narrow strait between the island of Salamis and the coast of Attica. The Persians under King Xerxes were decisively defeated, and Europe was saved from Asiatic conquest. The chief credit for this belongs to the cunning Athenian statesman Themistocles. He not only induced his fellow citizens to place their reliance in the "wooden walls" of the Athenian triremes, but also by a trick prevented the Peloponnesian vessels from retiring. Thus he brought on the battle in the narrow waters where alone the Greek navies might hope to triumph over the giant fleet collected by Xerxes. (*See* Persian Wars.)

SALEM, ORE. Northwestern Oregon's fertile Willamette Valley has made Salem a prosperous city. Salem is the state's capital and second largest city. It lies on the west bank of the Willamette River, at the head of navigation. From the valley's eastern edge rear the snow-capped heights of the Cascade Mountains and from the western edge, the Coast Range.

The valley's fields and orchards grow cherries, prunes, peaches, pears, berries, filberts, English walnuts, flax, hops, vetch, and beans. Milk and poultry are other important valley products. Most of the city's workers are employed in government offices and institutions, fruit-packing and canning plants, a paper mill, linen and woolen textile mills, and iron works.

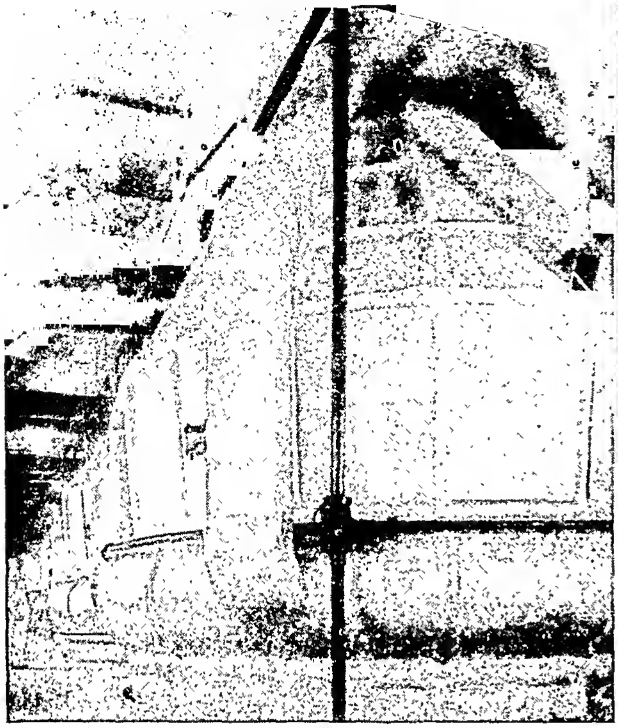
Near Salem's center in a landscaped area are Willamette University, the Capitol (completed in 1938), and other government buildings. Within or near the city are eight state institutions, including schools for the blind and deaf, a penitentiary, and a hospital.

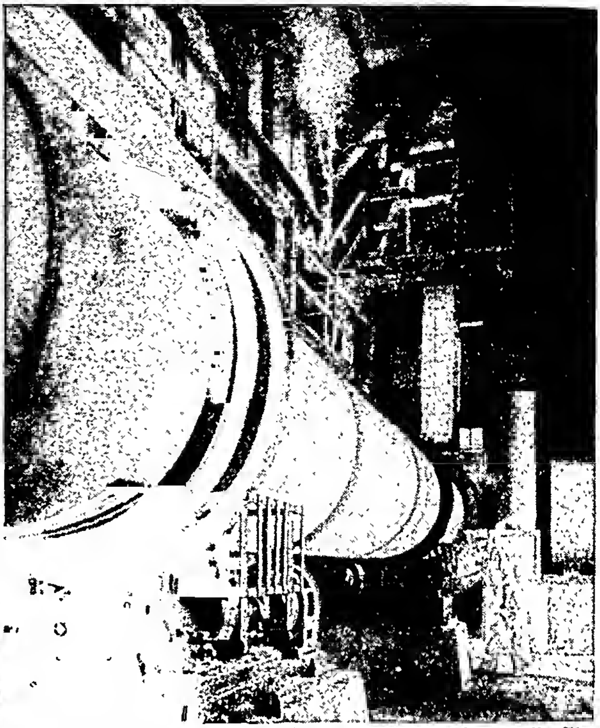
The site was settled in 1840 by Jason Lee, a missionary to the Indians. The fertile valley soon attracted settlers from the flood of immigrants trekking westward over the Oregon Trail (*see also* Oregon; Oregon Trail). The Oregon Institute, established as an Indian school, became a school for whites; in 1853 it was chartered a university, the first west of the Rockies. Salem was made capital of Oregon Territory in 1851; it remained the capital when Oregon became a state in 1859. In 1871 a railroad line up the valley to Salem was completed. Salem has the city-manager form of government. Population (1950 census), 43,140.

THE GREEK NAVY SAVES EUROPE AT SALAMIS

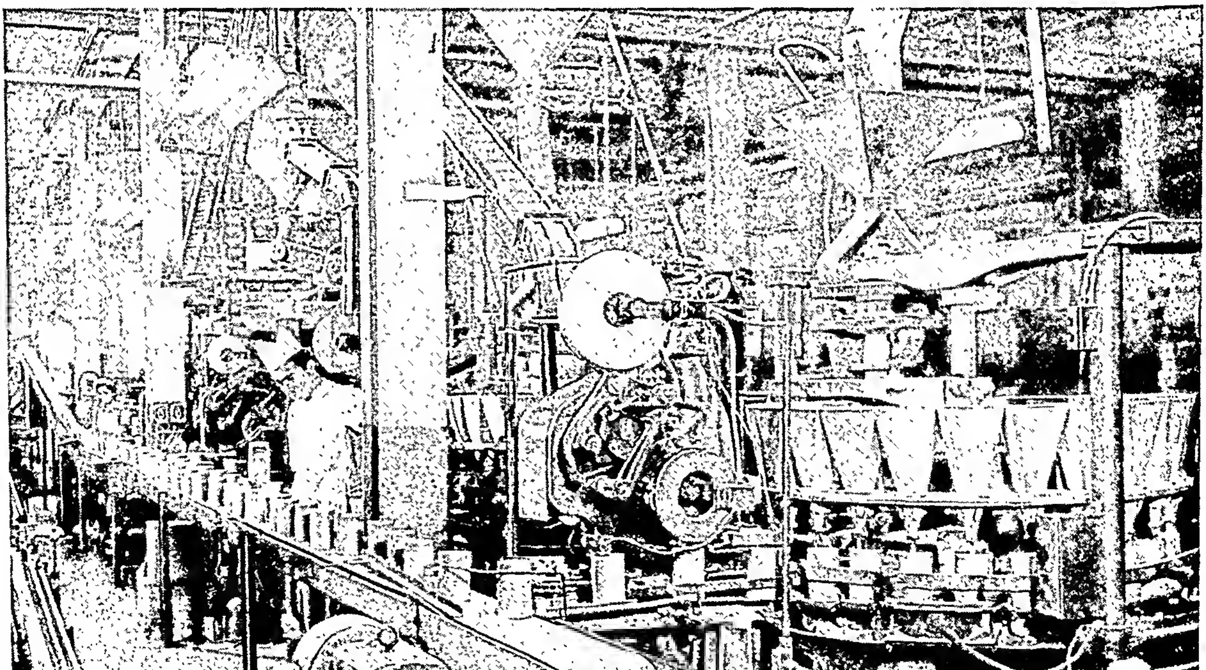
Here the Greeks are crushing the invading Persians by ramming their vessels while raining darts and stones upon the men. The Greek war galleys were specially designed for this kind of fighting—long and slim, packed with rowers below and soldiers on the light upper deck. All the details of costumes, ships, and weapons are based upon careful research.

HOW THE "SALT OF THE EARTH" REACHES OUR TABLES





These pictures from the International Salt Company show how table salt is obtained by evaporation of brine from deep wells. The brine is pumped into huge vacuum pans (left), 21 feet in diameter and 41 feet high. Steam evaporates the water, leaving behind salt crystals. These settle into the bottom of the pans. Then filters remove excess moisture. Finally 350 degrees of heat in rotary driers (right) removes the final moisture and sterilizes the salt.

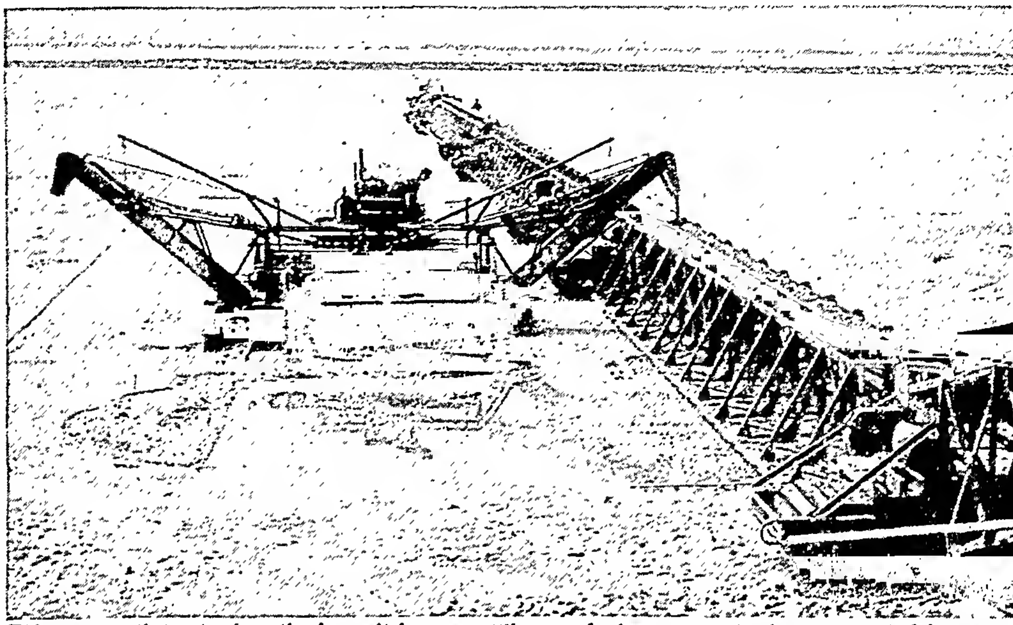


From the rotary driers the salt goes to mechanical filling machines. The round cartons are moved beneath the circle of filling funnels (right), then under a heat-sealing device which closes and seals the metal-pouring spouts. Then they move onto an endless belt (left) which carries the packages to the labeling machines.

was no supply near at hand it was brought from great distances, and thus became one of the most important articles of early commerce. One of the oldest roads of Italy was called the *Via Salaria* (salt road) because it was the route by which salt was transported. The caravan trade of the Sahara Desert was a trade in salt. In some remote parts of the world, such as Central Africa, salt is even today one of the most prized luxuries. Cakes of salt have even been used as money in Tibet and in the interior of Africa.

Salt was so valuable in early times that it gives us our word salary, from the Latin *salarium*, meaning "salt money"—the allowance given Roman soldiers to buy salt. Among the ancients, to "eat salt" with a man was to create a sacred bond of friendship, and this is so with some Oriental peoples today. In the Middle Ages one's social rank was shown by whether one sat above or below the salt at table. High taxes on salt were one cause of the French Revolution; and unrest in India at the time of the mutiny was brought to a crisis by the British monopoly on salt.

HARVESTING SALT FROM THE OCEAN



This mammoth tractor is gathering salt from a settling pond where sea water has evaporated for seven months. It drops its giant left arm—a suction dredge—and sucks up the thick salty residue. This brine is pumped through the spout in its right arm onto an endless belt that runs over the movable pier, on its way to be refined into the product we use to season our food.

Of the millions of tons of salt produced annually in the world, only about 3 per cent is used for human consumption. Large quantities are needed for meat packing and curing and for preserving fish. Salt is also employed in refrigerating and in the metal industry; and it is one of the most used basic materials in chemicals. From it is made sodium carbonate (Na_2CO_3), indispensable in the manufacture of glass and soap, as well as sodium hydroxide, chlorine gas, hydrochloric acid, bleaching powder, and sodium sulphate, all of which have important uses in industry and medicine. Salt cake is sodium sulphate formed in the manufacture of the carbonate. Crystallized sodium sulphate is Glauber's salt, the chief medicinal agent in the mineral waters of Karlsbad. The "hypo" of photography is sodium thiosulphate.

Epsom and Rochelle Salts

Iodized salt, which is common salt with a small amount of iodine compound added, is valuable in the treatment of goiter, and is used in regions where goiter is prevalent. Epsom salt is a hydrous sulphate of magnesium. It gets its name from Epsom, England, where it is found in the water of a spring. Seidlitz powders or Rochelle powders are drugs composed of tartrate of soda and potash, mixed with bicarbonate of soda and wrapped in a blue paper, and powdered tartaric acid wrapped in a white paper. When the contents of the two papers are dissolved separately in water and then poured together, the mixture effervesces and may be taken as a mild aperient.

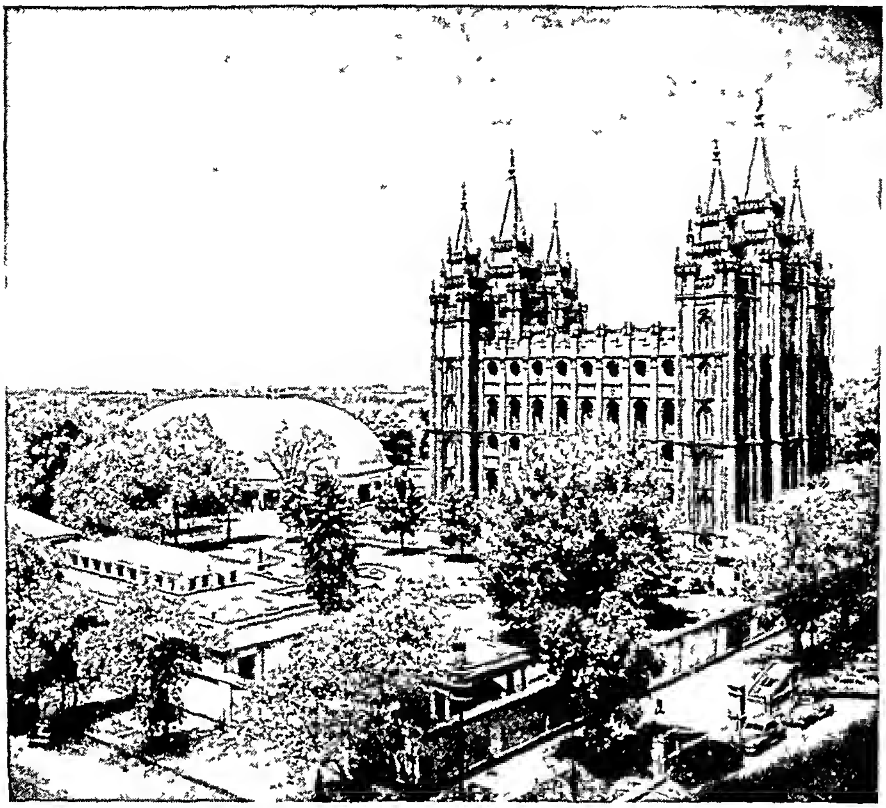
SALT LAKE CITY, UTAH. In 1847 Brigham Young led a band of Mormons westward across the plains and mountains to seek a new home free from persecution. When the wanderers came out on the western side of the mountains overlooking the valley of the Great Salt Lake, Young exclaimed, "This is the place!" An imposing monument commemorates these inspiring words. It now stands near this spot. It was designed by his grandson, Mahonri Young, and was erected during Salt Lake City's centennial in 1947.

Salt Lake City is the capital of Utah and the only large city between Denver and the Pacific coast. It is the world capital of the Mormons or Latter-day Saints (*see* Mormons). The city stands at an altitude of 4,354 feet in a valley cupped by the snow-capped rugged Wasatch Mountains. Cool waters from these mountains flow along the residential streets, freshening their trees and flowers. Across the alkali flats, 12 miles to the northwest, is the inland sea of the Great Salt Lake (*see* Great Salt Lake).

In the center of the city, surrounded by beautiful grounds, are situated the chief buildings of the Mormon church. The Tabernacle, a large oval building which seats 8,000 people, is noted for its remarkable acoustic properties and the large pipe organ it contains. This building and also the Assembly Hall, which is used for religious services, are open to the public. Only Mormons, however, are admitted to the Temple, which is an imposing granite structure used for marriage, prayer, and baptism. Other buildings of note in the city are those of the University of Utah,

the State Capitol, the city and county building, the museum, the exposition buildings, and the huge warehouses of Zion's Cooperative Mercantile Institution. In Temple Square is the Sea Gull Monument.

TEMPLE SQUARE, SALT LAKE CITY



To the right is the great many-spired Temple, which none but Mormons are allowed to enter. To the left is the low spreading dome of the Tabernacle, the chief place of worship for the Mormon people. It is world-famous for its huge pipe organ

Salt Lake City, through its central position, has become an important air line junction point, and a trade center not only for all of Utah, but also for parts of Idaho, Wyoming, and Nevada. It is a leading wool and cattle market. Factories in the city manufacture dairy products, packed meat, flour, candy, woolen goods, clothing, salt, copper, refined petroleum, brick, glass, paint, paper, insulation, and foundry and machine-shop products. Near by are many beet-sugar and canning factories, refineries, and smelters. Thirty miles south, at Geneva, is a large steel mill built at a cost of $200,000,000.

At first the growth of the city depended upon the inflow of Mormon converts from Europe and America. Later the mines and mills attracted many "gentiles" (non-Mormons). About half of the people belong to the latter group. Population (1950 census), 182,121.

SALTPETER. Ordinary gunpowder and fireworks depend for their explosive action in large part upon the saltpeter which they contain. To the chemist common saltpeter is known as "potassium nitrate," and he will tell you that its chemical symbol, which shows what it is composed of, is KNO_3. (*See* Chemistry.) He will also tell you that it forms colorless six-sided crystals, that its taste is cooling and very salty, that it dissolves in water but not in alcohol, that it is used in many ways besides in fireworks and gunpowder, and that it is found naturally in the soil of many countries, and especially in the caves of Kentucky, Virginia, and Indiana.

Common saltpeter, however, is usually manufactured from another form which is found in Chile (South America) in great beds, sometimes 10 feet thick, lying in an area 450 miles long by 5 to 40 miles wide. This is called *sodium nitrate* (chemical symbol $NaNO_3$). It cannot be used for gunpowder because it gathers moisture from the air, but this very fact makes it all the more valuable as a fertilizer.

A third kind of saltpeter, also a fertilizer, is *calcium nitrate* ($CaNO_3$). It often forms on walls of stables.

The word saltpeter means "stone salt" (from Greek *petros* for stone; Latin *sal* for salt).

SALVADOR (*sal-vä-dōr'*), **EL.** Though it is the smallest of the Central American republics, El Salvador has achieved a higher degree of material progress than most of its neighbors. It is the most densely populated country on the mainland of the Americas. In its small area—about that of Maryland—the people average 141 to the square mile, and about 80 per cent of the land is cultivated. Though it fronts only on the Pacific, its foreign trade exceeds that of some of its sister nations which have both Atlantic and Pacific ports.

The country is crossed by two high mountain ranges. In the tropical valleys decomposed lava makes a fertile soil. Coffee, which provides from 80 to 90 per cent of the exports, grows on the mountain slopes.

Other exports are sugar, indigo, henequen, and rice. Corn, beans, and rice are the chief food crops; cotton and tobacco also are grown, and cattle are raised. El Salvador suffers from being a "one-crop" country, and the people are being encouraged to try new crops. Gold and silver are mined to some extent. Deposits of copper, lead, mercury, and iron await exploitation.

The Balsam Coast, a small strip on the Pacific, is the sole source of the misnamed Peruvian balsam. This valuable product is the juice of a wild tree related to the acacia. It is exported for use in making perfumery and medicinal compounds.

Salvador has the most curious, the most dangerous, and the most beautiful volcanoes in America. It is a land where the earth trembles frequently, where lakes rise and fall, and where peaceful rivers suddenly become rushing torrents. There is no more wonderful volcano in the world than Izalco, the "Lighthouse," so called because its red glow makes it visible to sailors by night. This cone began to rise out of the plain over a century ago and is now more than a mile high, having built itself up by its own ashes. The majestic San Salvador, overlooking the capital city of the same name, had been dormant since the occupation of the Spaniards and was thought extinct. Suddenly, in 1919, this volcano belched forth from fissures in its sides enough lava to fill two Panama canals. The eruption, with the accompanying earthquake, destroyed nine-tenths of the city. Twice before within a century earthquakes destroyed San Salvador.

The country has an excellent system of roads and was one of the first to complete its share of the Inter-American Highway. It has well-paved and sanitary cities, and it has efficiently operated telegraph, telephone, mail, and radio services. The International Railways, which connects with Guatemala's interoceanic railway system, links the capital with the chief port, La Unión (Cutuco), on the Gulf of Fonseca, and with the other chief cities—Santa Ana, San Miguel, Acajutla, and Ahuachapán. There is also air service from San Salvador to the United States and to the capitals of other Latin American states.

El Salvador was named by its Spanish conqueror, Pedro de Alvarado, after the "Holy Savior" (San Salvador). Its people are largely of mixed Spanish and Indian blood, and speak Spanish. With their neighbors they revolted from Spain in 1821 and had a turbulent history up to the time of the Central American agreement of 1907, sponsored by the United States. (*See also* Central America.) Area, 13,176 square miles. Population (1950 census), 1,855,917.

SALVATION ARMY. On the curbstone of a dreary gin-smelling street in London's East End, in 1865, stood an alert young Methodist revivalist named William Booth. Amid jeers and stones he began to pray for the rough men and women gathered about him. Yet despite this treatment Booth and a few followers (including his heroic wife) went there day after day to invite the people to meetings which they held—now in a tent pitched on an old deserted burial ground, now in a cheap dance hall or old warehouse—to bring religion to the poor of London's slums, and to do what they could to relieve misery.

"GENERAL" WILLIAM BOOTH

Not until retired by death, at the age of 83, did the old warrior relinquish command of the Salvation Army.

Such were the humble beginnings of the great Salvation Army under its "General," William Booth (1829–1912). Its organization and uniform were semi-military, and after 1878, when it first received its name, the growth was phenomenal. Today in more than 95 countries it is found vigorously living up to its aim "to bring spiritual and material benefit to those whom conservative religious bodies do not reach."

The able men and women of this self-sacrificing "army" go quietly about performing the task of "soul-saving." Realizing that privation has driven many persons to desperate courses, the organization has done great things in social relief. Thousands of confirmed drunkards who enter its ranks become, as a condition of membership, total abstainers. Thousands of ex-convicts are given a fresh start in life. Among the many establishments for lending a helping hand to "down-and-outers" are rescue homes, lodging houses, slum settlements, fresh-air camps, day nurseries, free clinics, homes for the helpless aged, labor bureaus, farm colonies, poor men's lawyers, free coal and ice distribution, Christmas dinners, anti-suicide bureaus, etc.

During the World Wars the Salvation Army brought recreation and the comfort of religion to Allied soldiers. They carried doughnuts and coffee to the muddy trenches of the first World War. In the second conflict they served bombed-out civilians, opened relief centers in China, and operated Red Shield clubs and canteens throughout the British Empire. In the United States they took part in the program of the United Service Organizations.

The Salvation Army is supported by voluntary contributions and by its many publications, among which are *All the World* and the *Young Soldier*. It has about 15,000 posts throughout the world and 1,500 social institutions, directed by more than 27,000 officers and cadets.

In 1896, Ballington Booth, son of General Booth, withdrew from the Salvation Army, of which he had

HOW THE SALVATION ARMY AIDS PEOPLE IN NEED

1. Salvation Army posts throughout the world hold thousands of street meetings each week to bring the gospel to people who might fail to attend church. 2. Here a "down-and-outer" applies for help and is welcomed by a Soldier. 3. A social worker talks with him about his needs and problems. 4. Useful work helps to rehabilitate him. Here he repairs furniture for needy families. 5. The army's wholesome social gatherings make him "feel at home" with people again.

been commander in the United States. With his wife, Maud Ballington Booth, he founded a new organization called the Volunteers of America. Its religious and philanthropic work is similar to that of the parent society, but the Volunteers encourage affiliation with churches and religious denominations.

SAMOA (*sä-mō'ạ*) Far off in the vast South Pacific lies a chain of 14 islands called Samoa—4,200 miles from San Francisco and 2,400 miles from Australia. These beautiful mountains in the sea rise to heights of more than 4,000 feet and were formed ages ago by the eruption of a group of volcanoes. A coral breakwater surrounds them. The total area of the group is 1,200 square miles, or about that of Rhode Island.

Wind and rain, weathering the lava through the centuries, deposited a rich alluvial soil over the islands. This good soil and the moist, warm climate make for abundant vegetation. Giant ferns, vines, palms, and hardwoods grow luxuriantly. Coconut palms and breadfruit trees furnish staple foods. Mangoes, bananas, yams, and taro—a starchy tuber—are plentiful. So are oranges, alligator pears, and pineapples. Mulberry trees furnish bark for tapa cloth. Animal life is scarce, but pigs and chickens have been imported. Most remarkable of the birds is a kind of ground pigeon—a relative of the extinct dodo—with iridescent greenish-black and chestnut plumage. The huge bats called flying foxes abound in the forests.

THE ENTRANCE TO PAGO PAGO'S LANDLOCKED HARBOR

The great sheltering shoulders of Rainmaker Peak dominate the entrance to the harbor at Pago Pago. Inside, lying in the crater of a submerged volcano, hemmed in by mountains and jungle, the waters are very deep and always quiet. The harbor affords protection in all kinds of weather and can accommodate the largest ships.

Native villages dot the level shores. The open houses resemble giant mushrooms set on tall poles, and roofs are thatched with sugar-cane leaves. The Samoan is a pure Polynesian. He is mild mannered, intelligent, fun loving, and friendly. With a few primitive tools, he cultivates taro, catches fish, and gathers food in the forest. The principal industry is drying copra (*see* Coconut Palm). Samoans are skilled in handicrafts. The single garment worn by both men and women is the lavalava (or sarong), but Western clothes are gradually taking its place.

Valued chiefly as convenient places for coaling stations on the South Sea trade routes, the islands were for many years the object of rivalry between the United States, Great Britain, and Germany. Finally, in 1889, all disputes were settled with the partitioning of the islands between Germany and the United States, Great Britain receiving compensation elsewhere. The United States obtained the seven eastern islands, with an area of 76 square miles. Germany received the rest. These latter islands became known as Western Samoa. After 1919 New Zealand governed this group, first under a mandate from the League of Nations; later as a United Nations trusteeship.

Most important of the American group is Tutuila. Here, at Pago Pago, the United States long had a naval and coaling station and an air field. Occupying the crater of an extinct volcano, Pago Pago's harbor is one of the finest in the South Seas.

On Upolu, chief island of Western Samoa, is the port of Apia. This little town has a radio station, hospital, bank, official buildings, and bungalows strung along the shore. In the hills nearby is Vailima, Robert Louis Stevenson's home (*see* Stevenson).

These islands were first sighted in 1722 by the Dutch. Louis de Bougainville explored them in 1768 and named them the Navigators Islands. In 1839 Charles Wilkes, leader of an American expedition to the South Seas, renamed them Samoa.

American Samoa was governed by the Navy until July 1, 1951. Then the Department of the Interior took over. Samoa now has a civilian governor appointed by the president of the United States. A native assembly (the Fono), reorganized in 1953, advises the governor. The senate has 15 members, chosen by chiefs. The lower house has 18 members, popularly elected by men and women 18 years old or more. Two women were elected to the house in the 1953 vote. Samoan schools teach English.

Western Samoa is governed by a high commissioner, a council of state, and a legislative assembly. Schools are conducted by the government and by missionaries. Scholarship winners attend school in New Zealand.

The population of Western Samoa is 68,197 (1945 cenus), including some 300 whites; population of American Samoa, 18,937 (1950 census).

SAN ANTONIO, TEX. In the heart of southern Texas, midway between the Rio Grande and the Gulf Coast, the Spaniards in 1718 founded a presidio named San Antonio de Bexar and a mission called San Antonio de Valero. This fort and church were beautifully located on a plateau rimmed by misty blue ridges. Near by a number of clear springs bubbled up, forming a small river which was also named for Saint Anthony. On this spot today stands modern San Antonio, the third largest city in the state.

A Rich Historic Background

The river is now spanned by many bridges and the city has spread out over the surrounding hills; yet it remains a shrine of early Texas history. It was the capital of the Texas province during practically the whole of the Spanish and Mexican occupation, but was dominated always by a spirit of independence. When the Mexicans were struggling for freedom from Spain from 1810 to 1821, the city saw many fierce conflicts. And 15 years later, when the Texans won their freedom from Mexico, three battles were fought in or near San Antonio. The most famous of these was the siege of the Alamo mission fortress. At the end Davy Crockett and about 180 other heroic Texans were killed on March 6, 1836 (*see* Texas).

San Antonio retains many traces of Spanish and Mexican influence. Small plazas, vivid with bloom, are scattered through the city. There are the one-story adobe houses of the Mexican quarter, and minstrels singing and playing guitars for coins. There are the yearly week-long fiesta commemorating the Texans' victory at San Jacinto, innumerable spontaneous fiestas, and the ever-present tamale vendors. La Villita (Little Village) is an entire city block reclaimed from the slums and restored to its 18th-century appearance. The long, low Spanish Governors' Palace was purchased by the city in 1929 and faithfully restored to its former grandeur. The architecture of many of the public buildings and business houses is Spanish. The early history of the locality is also reflected in the old missions San José, San Francisco de la Espada, San Juan Capistrano, and Concepcion. The city block where the Alamo stands is a state park.

Oldest of the many army posts located here is Fort Sam Houston. The great airfields surrounding the city include Kelly, Brooks, and Randolph. So many army fliers have been trained at Randolph Field that it has been referred to as the "West Point of the Air."

An Attractive and Prosperous City

Brackenridge Park—320 acres within the city—is almost virgin woodland. Here are the Pioneer Memorial Building, dedicated to the Old Trail Drivers Association, Texas Pioneers, and Texas Rangers, and the Witte Memorial Museum. Here also are the San Antonio Zoological Garden, the Sunken Garden, the Civic Outdoor Theater, the Alpine Drive, and many other educational and recreational features. San Pedro Park, a picturesque live-oak grove, was the first public park of the city, being a royal grant from the king of Spain in 1731. In it rises San Pedro Creek, which flows through the western part of the city and unites with the San Antonio River.

After the coming of the first railroad in 1877, San Antonio became a great transportation, trade, and manufacturing city. It is now served by three main railroads, two transcontinental air lines, and five federal highways. Because San Antonio is nearly 200 miles from any rival business community, it is an important distributing center for southwest Texas and northern Mexico.

The city is a leading market for truck crops and livestock. It has meat-packing houses, flour mills steel works, cement plants, and garment factories. It is a center of the oil and pecan shelling industries.

San Antonio so delights visitors that it has become an outstanding winter resort. When poet Sidney Lanier visited the city in 1872 he wrote, "If peculiarities were quills San Antonio de Bexar would be a rare porcupine." Now, as then, the city is one of many contrasts, surprises, and charm.

Universities and colleges here are Trinity, St. Mary's, Incarnate Word, and Our Lady of the Lake. In 1952 San Antonio adopted the city-manager form of government. Population (1950 census), 408,442.

SAND. Sand is simply a collection of tiny rocks. Like other types of soil, it comes from the breakup in ages gone by of the solid rocky surface of the earth (*see* Soil). But the rock fragments that formed sand were those too hard or too resistant to chemical action to be broken up or dissolved into a fine powdery mass like other soils. Instead, they remained in gritty particles from a tenth to a hundredth of an inch in diameter.

How did these grains of sand become separated from the finer, softer soils, so that we so often find them in huge deposits in the beds of streams and along the shores of the ocean? We can find the answer if we put a mixture of gravel, sand, and fine soil in a can or box and shake it from side to side for a few minutes. The coarse gravel will come to the top, the sand will be next, and the fine powdery soil will make its way to the bottom of the container. This is always the result when objects of about the same density but of different sizes are shaken up together. The smaller objects sift through the open spaces left between the larger ones and so gradually work down under them and force them to the top.

So, when gravel and sand were formed in the breakup of ancient rocks, they tended always to remain on the surface. There floods and torrents could get at them and roll them along down into the valleys and river beds. As they rolled, many of the gravel pebbles were cracked and worn down into sand grains.

Many Different Kinds and Colors

We can tell something of the history of sand grains by examining them with a magnifying glass. Smooth, well-rounded particles either have traveled far or have been continually churned around like those on the surf-beaten shores of the ocean. Those with sharper edges have splintered off more recently and have not strayed far from their origin. As a rule

Direct-color photograph *By John Kabel*

A WIND-BLOWN SEA OF SAND

These typical dunes resemble great ocean waves covered with small ripples. Wherever large masses of dry sand are exposed to the wind, they take on shapes like these. And the dunes are constantly changing and shifting except where plants manage to overrun and capture them.

each grain is composed of only one mineral, but there may be a variety of mineral species in one handful of sand. The most common is quartz sand (*see* Quartz). Pure white and silvery sands are not uncommon, but shades of yellow, brown, and red predominate owing to the presence of iron compounds. Magnetite sand is black or gray and glauconite sand is green. There are sands which contain gold, zircon, garnet, pyrites, and other rarer minerals. The so-called "white sands" of New Mexico are nearly pure gypsum. Arkose sand contains feldspar, hornblende, mica, etc. Sands made of fine grains of olivine are found along the Bay of Naples.

A sand of wholly different origin is shell sand. It consists of fragments of shells and coral ground up by the waves. Great deposits of shell sand lie on the coasts of Devonshire and Cornwall in England, in Bermuda, and on the shores of many Pacific islands.

How Sand Dunes Grow and Wander

Dry sand is blown about extensively by the wind. Any obstacles on the surface, such as rocks, stumps, or shrubs, will stop some of it, forming little mounds. These block more sand until they grow into high ridges and hills called dunes. These mounds, or dunes, are common along sandy shores. They abound also in many deserts and in semiarid regions, such as western Nebraska.

Unless anchored by vegetation, dunes are likely to migrate by the slow shifting of the sand from windward to the leeward side of the dune. Migrating dunes have invaded many a fertile farm and fruitful orchard. Near Manistee, Mich., a bonfire built by picnickers on a stationary dune burned off the grass which held it in place. The wind biting into the bare patch undermined the live grass left around the edges and soon stripped one side bare. Then the great hill of sand began to roll forward, and before it was pinned down by replanting it almost buried the city waterworks and other property. In New Zealand, sheep pastured on grass-covered dunes have done similar damage. The great estate of Culbin, on the northern coast of Scotland, celebrated for its fertility, was engulfed in sand toward the end of the 17th century, and ever since the entire region, about 3,000 acres, has been a shifting waste. Large cities lie buried under the sand hills of the Gobi Desert in Central Asia.

Fortunately, wandering dunes may be fixed: (1) by the erection of artificial barriers, fences, or hurdles; and (2) by the planting of grass and other vegetation which will grow in sand. Both means were employed in the redemption of the "Landes" of Gascony (France) on the Bay of Biscay. A hundred years ago this region was a vast sandy wilderness marching inland at the rate of about 16 feet a year; today it is a great pine forest, a source of lumber and turpentine sheltering a rich inland farming region.

Wet Sand and Sandstone

Sand mixed with water behaves very differently from dry sand. Walking along the dry part of a sandy beach our feet sink deep. But when we step over to the wet strip along the shore we find a firm and solid footing. On the Florida coast at Daytona Beach, the damp, hard-packed sand beach has often been used for automobile racing. Firmness is characteristic of sand wet with just enough water to fill the spaces between the grains. Quicksand, on the contrary, is sand so saturated and churned up in water that it will support no weight (*see* Quicksand). In ages gone by, sediment from ancient oceans and lakes deposited itself on sandy bottoms. The sediment contained lime, chalk, and silica from the shells and bodies of billions of water creatures. It penetrated between the sand grains and later, under heavy pressure of the overlying deposits, it cemented them together into *sandstone.* Thus the tiny fragments of primitive rocks were turned into solid rock again. Still later, vast layers of this sandstone were thrust up into dry land by movements in the earth's crust and are found today in many parts of the earth (*see* Rock). Certain varieties of sandstone are used for building, others for grindstones. *Quartzite* is a rock in which the silica cement has crystallized around grains of quartz sand.

Mysterious Music of the Sands

So-called "musical," "singing," or "barking" sands occur in various parts of the world. Sand on the beach near Manchester, Mass., gives a crackling sound when walked upon. The "singing sands" of Mount Sinai are said to give a harplike note when masses of it are tumbled down hill. Under the same conditions sands on the Hawaiian island of Kauai produces a deep note, but when stirred up with the hands they emit a sharp barking sound. In many places windblown sands remind people of a humming telegraph wire. The cause of these sounds has been much discussed. One explanation is that the grains of the sand in question are all of the same size and shape. When slightly damp so that an elastic film of moisture surrounds each grain, the sand is easily set into uniform vibration.

Uses of Sand Are Legion

Sand is an important ingredient of mortar, of concrete, and of asphalt pavings, and is used for molds in metal foundries. Bricks made of clay mixed with sand are harder and will bear a greater weight than bricks of clay alone. Sand is used as a filter to purify water. It is an excellent abrasive. Glued to paper it makes *sandpaper.* Blown through a hose by compressed air or steam, it gives us the *sandblast,* which is used to clean the fronts of brick or stone buildings, to scour rust and corrosion from metals, for engraving glass, cutting inscriptions on monuments, and many other purposes.

Sand with a high percentage of silica is demanded for glassmaking, the grade of glass varying with the purity of the sand (*see* Glass).

SANDALWOOD. The fragrant and fine-grained sandalwood, so prized by the Chinese and East Indians for making elaborately carved boxes and the fragile carved sticks of fans, comes from certain tropical islands of the Pacific Ocean and East Indies.

In 1804 these myrtlelike evergreens were discovered to be native to the Fiji Islands. This led to the first European settlement there.

The Chinese grind sandalwood into a powder, make a paste of it, then mold the paste into a spiral taper. They burn the tapers in their temples and on the altars of household shrines. Hindus color the paste a bright vermilion and use it to make caste marks on the forehead. The funeral pyres of Indian princes are built of the sweet-scented sandalwood.

There are several species of sandalwood trees, all belonging to the genus *Santalum.* The tree is cultivated in India on plantations. It seldom exceeds 30 feet in height and a foot in diameter. The fragrance of the wood comes from its essential oil. The roots are richer in oil than the branches and trunk. The oil is valuable in medicines.

SANDBURG, CARL (born 1878). In 1914 Carl Sandburg's poem 'Chicago' appeared in *Poetry: a Magazine of Verse.* At once it aroused a storm of criticism. Readers thought that such phrases as "hog butcher for the world" were too vulgar for poetry. But Sandburg was using the strong, simple language of plain people, and gradually he was recognized as a new voice in American literature. Today he is one of the most beloved American poets. His 'Abraham Lincoln: The War Years' won the Pulitzer prize for history in 1940, and his children's stories are widely read.

Sandburg was born Jan. 6, 1878, in Galesburg, Ill. His parents were Swedish immigrants. When he was 13 he quit school to help earn the family living. He delivered milk, swept floors, and shined shoes. When he was 17 he worked in the Kansas wheat fields. There he made friends with hoboes and farm hands. Their stories and songs started his rich collection of poetry material.

After serving in the Spanish-American War, Sandburg enrolled in Lombard College in Galesburg. He worked his way through but left shortly before graduating. For six years he roamed from one job to another. In 1908 he married Lillian Steichen and settled in Milwaukee. They had three children. For two years he worked as secretary to the mayor of Milwaukee. Then in 1913 the Sandburgs moved to Chicago. After holding several editorial jobs Sandburg became a reporter on the *Chicago Daily News.* He stayed in Chicago many years.

CARL SANDBURG

Sandburg won fame as a poet, but he was noted as well for singing American ballads, accompanied by his guitar.

Here Sandburg continued writing poetry. It was filled with sayings, scraps of anecdotes and conversations, and descriptions of both steel mills and farms. He was an early exponent of *free verse*—verse without a definite rhyme or metrical pattern. Sandburg's volumes of poetry include 'Chicago Poems' (1916), 'Smoke and Steel' (1920), and 'The People, Yes' (1936). For a long time he collected material on Lincoln for a children's book. The subject proved so vital that he wrote an adult biography in two parts—'Abraham Lincoln: The Prairie Years' (1926) and 'Abraham Lincoln: The War Years' (1939).

To support his family while writing, Sandburg gave recitals. He read his poetry and sang folk songs in his slow, deep voice, accompanying himself on the guitar. He collected his favorite ballads in 'The American Songbag' (1927). He also wrote such children's books as 'Rootabaga Stories' (1922). His first novel, 'Remembrance Rock', was published in 1948 and his partial autobiography, 'Always the Young Strangers', in 1953. In later years he lived in Harbert, Mich., then moved to Flat Rock, N. C.

SAN DIEGO (*săn dĭ-ā'gō*), **CALIF.** For more than four centuries, explorers, traders, and settlers have been attracted to San Diego, in the southwest corner of the United States. The site offers an excellent natural gateway to the country, with its landlocked harbor, San Diego Bay.

In addition to the bay, San Diego enjoys the advantage of a superb, even climate. Steady northwesterly winds prevail for nine months a year. These maintain a mean annual temperature of 61.4°F. with only slight variations (55° in January to 68° in July). Annual rainfall is about ten inches. The bay and climate have been the chief factors in making San Diego important.

The bay itself is hook-shaped. The point of the hook, Point Loma, extends south into the Pacific Ocean. Rising into the curve of the hook is a long sandspit extending from the southeastern mainland. On the end of the spit stand the city of Coronado and the naval air station, North Island.

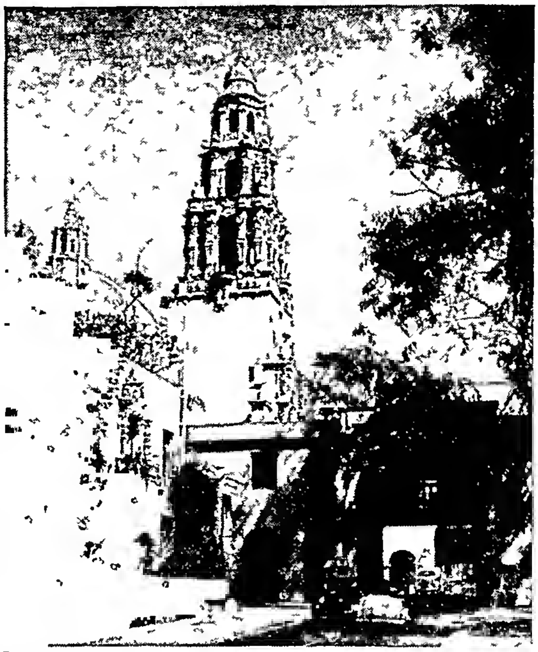
Within the sheltered area behind the spit, the harbor has more than 70 docks, wharves, and piers for naval and civilian shipping and for fishing boats. The port handles about 2 million tons of shipping yearly. A great part of this total is petroleum. Most of the bay area is used by the United States Navy. In addition to the naval air station, there are a naval training center, naval base, marine corps base, naval hospital, and a coast guard "air-sea rescue" base.

San Diego's mild, sunny climate attracts thousands of visitors yearly. A great center of interest is

the 1,400-acre Balboa Park, where international expositions were held in 1915–16 and 1935–36. The park's permanent attractions include museums and galleries, a huge outdoor organ pavilion, a zoo, a stadium, and other sports and recreational facilities. North of Point Loma is the community of La Jolla (pronounced *la hoy'a*). Located here is the Scripps Institution of Oceanography.

The city's industries include tuna canneries, large aircraft factories, olive-packing plants, and garment factories. The San Diego area produces about half of the avocados grown in the United States and a large percentage of cut flowers and bulbs. The city is served by major railroad, bus, truck, and airlines. Lindbergh Field is the municipal airport.

BALBOA PARK SHOWPLACE



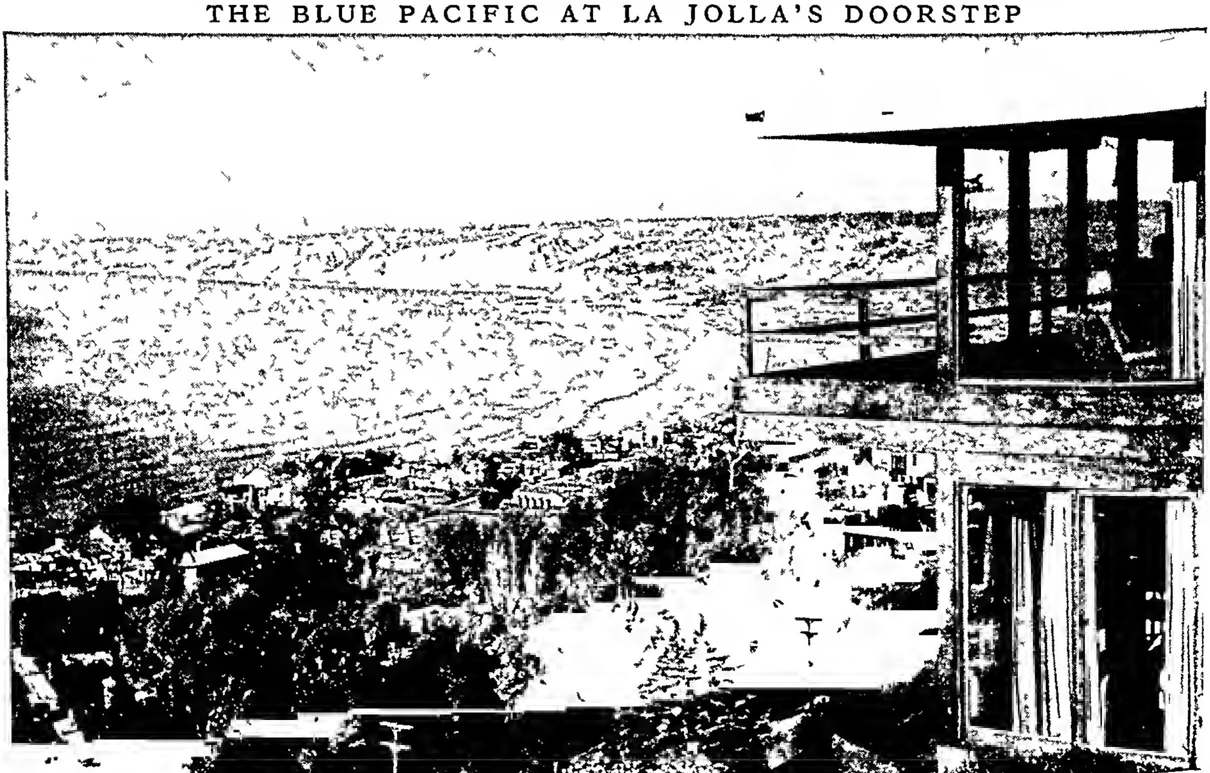
In the center of the permanent buildings of Balboa Park in San Diego stands California Tower. It was a center of attraction at the Panama-California Exposition (1915) and the California Pacific International Exposition (1935).

San Diego harbor was discovered in 1542 by Juan Rodriguez Cabrillo, a Portuguese navigator in the service of Spain. On the tip of Point Loma are a Spanish lighthouse and the Cabrillo National Monument Sixty years later, the site was named San Diego to honor San Diego de Alcalá.

Then in 1769 an expedition directed by Gen. José de Galvez established the first presidio and Father Junípero Serra founded the first of the famous chain of missions in California. From here Father Serra began building missions along El Camino Real, "the King's Highway." The American flag was raised over the town during the Mexican War in 1846. San Diego was incorporated in 1850 under the laws of the new state of California.

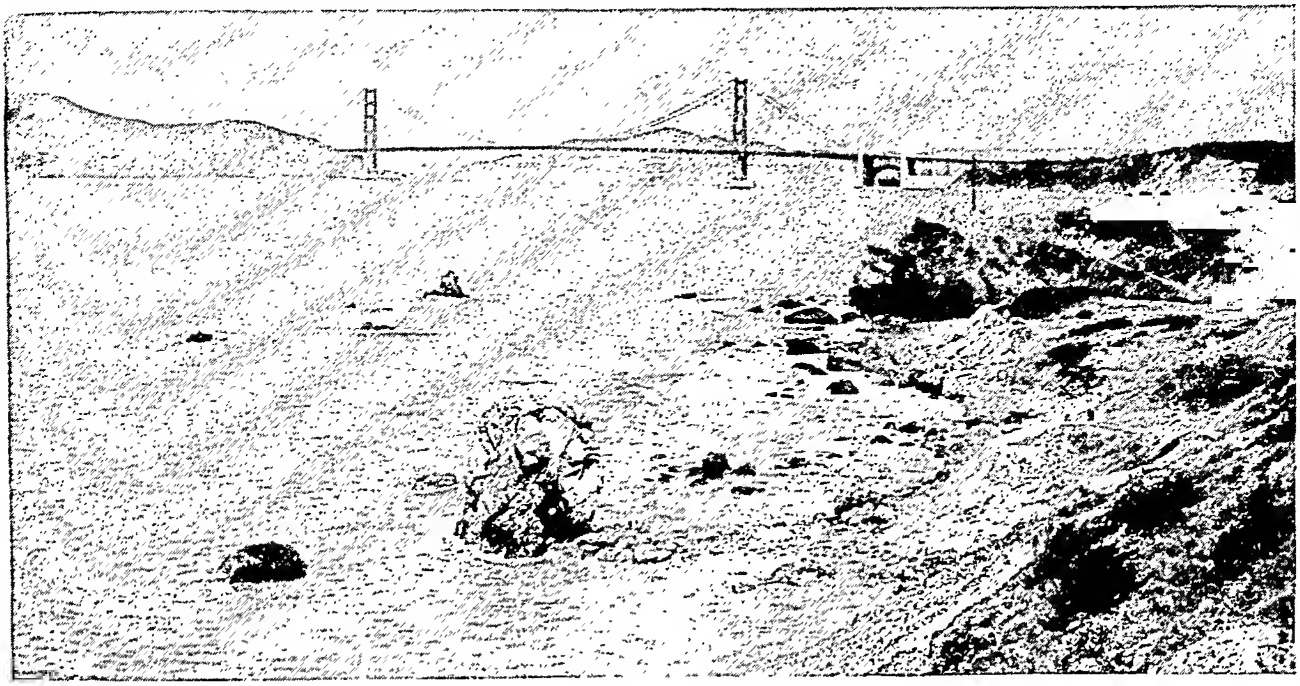
San Diego remained a sleepy village. In 1867 Alonzo E. Horton began developing the port. In 1885 the first railroad linked San Diego to transcontinental lines. In 1932 the city adopted council-manager government. World War II brought many new residents. Population (1950 census), 334,387 (1952 special census, 434,924).

THE BLUE PACIFIC AT LA JOLLA'S DOORSTEP



At San Diego's beautiful residential and resort suburb of La Jolla, many of the homes look down on the Pacific Ocean from the sides of the bordering mountain. Beyond to the north stretches the dry, clifflike coast line of southern California. The climate is said to be the least variable in the United States. This area attracts many retired people as permanent residents.

The CITY *on America's* "GOLDEN GATE" *to the* PACIFIC



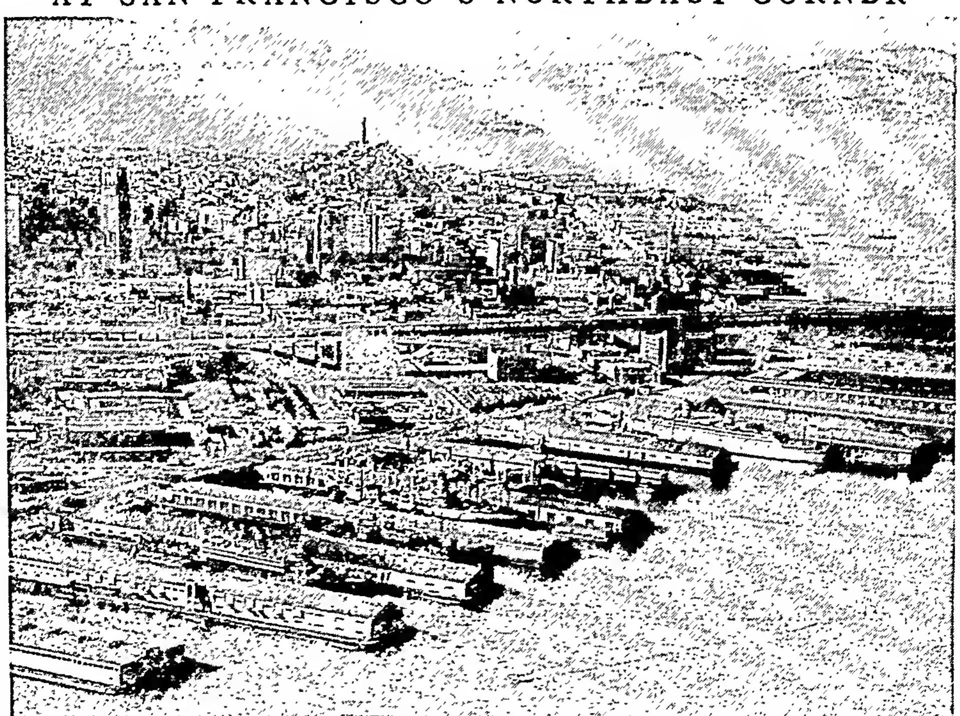
Between San Francisco Bay and the Pacific Ocean Lies Golden Gate, Spanned by the Golden Gate Bridge

SAN FRANCISCO, CALIF. The Golden Gate is a narrow break in the long chain of mountains down the coast of California. Only two miles at its widest and four miles long, it leads from the Pacific Ocean into the great landlocked harbor of San Francisco Bay, which covers 450 square miles. The city of San Francisco, one of the most beautiful in the world, lies on the end of a hill-studded peninsula which thrusts up from the south to form the southern side of the Gate. Thus from the city's western side San Franciscans look out to the open ocean. From the eastern side they look across the bay toward Oakland. Across the Gate to the north they see the rocky, forested hills of the Marin peninsula.

The warm winds from the ocean are cooled by a cold ocean current off San Francisco and often condense into thin gray fogs. These same winds give the city its cool, even climate.

San Francisco is a magic name. The magic is compounded of sea, fog, and mountain, of memories of gold rush days, and lusty stories of Mark Twain, Ambrose Bierce, and Jack London. With a rich continent behind it and the Orient trade ahead, it became a great seaport, drawing to it the peoples of many nations. Its Chinatown is the largest in the Western world. On the slopes of Telegraph Hill is the Latin Quarter, where French, Spanish, South Americans, and others mingle. Russian Hill, near by, has

AT SAN FRANCISCO'S NORTHEAST CORNER



In the foreground are piers that back up to the broad Embarcadero. The San Francisco-Oakland Bay Bridge rises in the heart of the city and spans the bay. Scott Tower on Telegraph Hill looms in the background and beyond it in the bay is Alcatraz Island Federal Prison.

many legends to account for its name. The busy water front (a part of which is called the Embarcadero) shelters ships from many maritime countries. A picturesque feature is Fisherman's Wharf, with its restaurants.

This water front smells characteristically of China tea, fish, Calcutta jute, coconuts, pineapples, raw sugar, Brazilian coffee—the imports from far distant lands. From the city's mills are exported refined oil and sugar, canned foods, grain, flour, and cotton.

The Great Valley on the mainland pours agricultural products and minerals into the city and is an important factor in its prosperity. Meat packing, food canning, shipbuilding, oil refining, spice grinding, coffee roasting, sugar refining, bag making, and the manufacture of clothing, furniture, iron and steel products are all leading industries.

IMPORTANT FACTS ABOUT SAN FRANCISCO

Population (1950 census), 775,357.

Geographic Location (radio station KNBC, east tower)—37°32′ N., 122°13′ W.

Climate—average annual temperature, 56.5° F; warmest month, September (mean temperature, 61.5°); coldest month, January (mean temperature, 50.1°); annual rainfall, 22.18 inches; wettest month, January (4.75 inches); driest month, July (.01 inch).

Port and Shipping—in San Francisco Bay area (including San Francisco, San Pablo, and Suisun bays) about 275 docks and piers; 28 miles improved water front In San Francisco proper, about 100 docks and piers. Commerce through San Francisco Bay (5-year average): exports, about 3,700,000 tons; imports, about 882,000 tons; coastwise, about 16,111,000 tons.

Public Transportation—about 100 miles of streetcars; 18 miles cable cars, 400 miles motor coaches, 102 miles trolley coaches.

The Effects of the Earthquake

A severe earthquake and a fire which followed, from April 18 to 21, 1906, killed about 500 people, destroyed four square miles (approximately 490 city blocks) of buildings, and caused an estimated property loss of $500,000,000. The city lost many links with the past. The old sea-misty buildings of brick and of redwood have been replaced by modern structures of concrete and terra cotta. Old Chinatown is gone; the new one, though strange and exotic enough, is vastly more sanitary. It uses telephones enough to need a large exchange with Chinese operators. The Chinese are very much a part of the city's life. Their lacquered bazaars of Grant Avenue are only a few minutes' walk from the fashionable shops of Union Square.

A fitting symbol of the new city is the magnificent civic center, with public buildings grouped about an imposing plaza. The dome-crowned City Hall and a group including the public library, the State Building, an auditorium, and the War Memorial, comprising the Opera House and a Veterans' Building, are here.

Among San Francisco's proud memories are its expositions. The Panama-Pacific International Exposition of 1915 was held to celebrate the opening of the Panama Canal. The city's island airport of 400 acres was built in San Francisco Bay as Treasure Island, the site of the Golden Gate International Exposition of 1939 and 1940.

Streets and Hills

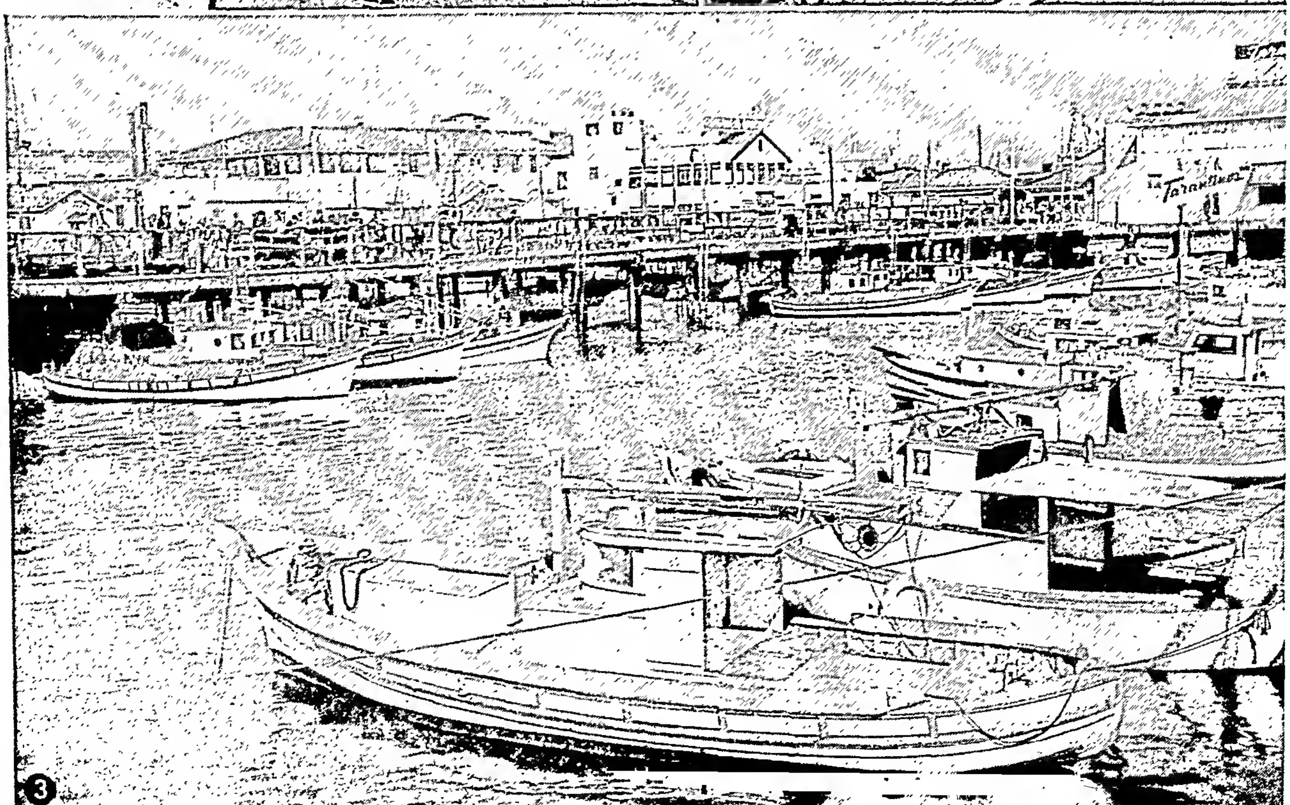
The axis of San Francisco is Market Street, a busy thoroughfare with four lines of car tracks. It crosses the city from northeast to southwest. Montgomery Street has been called "the Wall Street of the West," for it is the heart of the financial district. The streets run at right angles, regardless of the hills on which the city is built. In many places they are so steep that people climb, rather than walk, up them. The hills—there are Nob and Telegraph and Twin Peaks and Russian Hill and many others—rise so abruptly that a cottage may look down on a skyscraper and command a view of the whole city.

Golden Gate Park spreads over more than a thousand acres and runs from the center of the city three miles westward to the ocean. Here sight-seers can ride past Steinhart Aquarium and Kezar Stadium, along the sea, and view clusters of scarlet and magenta rhododendrons They can study the seals of Seal Rocks and the stout ship *Gjoa,* in which Roald Amundsen's band of explorers first traversed the Northwest Passage. They can see the old United States mint, converted in 1955 into an assay office. Just inside the Golden Gate is the historic presidio, now a military reservation and headquarters for the United States 6th Army. To the west, in Lincoln Park, is the Palace of the Legion of Honor, presented by Mr. and Mrs. A. B. Spreckels as a memorial to those who served in World War I. The palace is built on cliffs overlooking the Golden Gate. It has long galleries for permanent and loan collections of all types of art.

San Francisco is a city of noted restaurants with exotic cookery—a city where people know how to play. Young folks in hiking clothes can be seen pouring across the Golden Gate Bridge ready to climb Mount Tamalpais. Whole families spend week ends on houseboats in the bay or at lodges in the mountain canyons. Golfers tramp over green courses stretching along the windy hills.

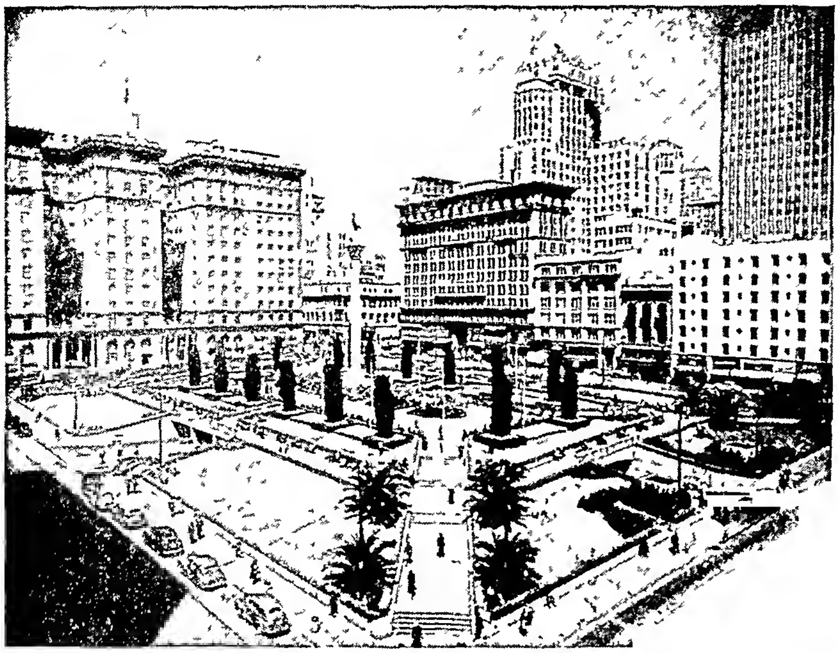
The city has its own symphony orchestra. Among the writers either born in San Francisco or else closely associated with it are Bret Harte, Jack London, Mark Twain, Ambrose Bierce, Frank Norris, Will Irwin, Charles W. Stoddard, Charles and Kathleen Norris, and Gertrude Atherton. Rudyard Kipling and Robert Louis Stevenson loved San Francisco. The city produced the sculptor Robert Aitken, David Warfield and David Belasco of theatrical fame, and many other artists. The city has produced many famous athletes.

The University of San Francisco, the San Francisco College for Women, the San Francisco State College, the school of medicine of Stanford University, and the schools of fine arts, law, medicine, dentistry, and pharmacy of the University of California are in the city. Near by are Stanford University at Palo Alto,



1. California Street, like many others in San Francisco, rises sharply with level grades at the intersections. A glimpse of Chinatown halfway up contrasts pleasingly with fine hotels at the top. 2. San Franciscans cling sentimentally to their cable cars. Here at the end of the Powell Street line, the car swings around on its turntable for its return trip. 3. On the north shore is Fisherman's Wharf. It is the harbor for the fishing fleet and the home of many famous sea-food restaurants.

UNION SQUARE IN THE HEART OF THE CITY



At the base of Nob Hill stands beautiful Union Square, adjacent to fashionable shops and hotels. Under the square is a huge parking space for automobiles.

the University of California at Berkeley, Mills College at Oakland, and St. Mary's College of California.

San Francisco's Life Story

Juan Rodriguez Cabrillo and Sebastian Vizcaino failed to discover San Francisco Bay as they explored the coast. Sir Francis Drake sailed straight past the Golden Gate in 1579 to plant the English flag on Drake's Bay to the north. Then, in 1769, Don Gaspar de Portolá, Spanish governor of Lower California, stumbled upon the bay while searching for Monterey Bay. He named his find after St. Francis, the patron saint of the expedition. Juan Bautista de Anza brought colonists and mission fathers in 1776 and built a presidio and the Mission Dolores. The little Spanish settlement was called Yerba Buena ("good grass") before its name was changed in 1847 to San Francisco (*see* Southwest, American).

Mexico ruled the village after 1821 until it became part of the United States. Then gold was discovered thereabouts, and fortune hunters rushed to San Francisco from all over the world (*see* California). The Southern Pacific Railroad, built eastward from the bay, met the Union Pacific extending westward. In 1869 the first transcontinental railroad was completed.

City and county governments are united in San Francisco under a board of supervisors, a mayor, and other elected officials. The city has had several charters since its first one, dated 1850.

More than 30 years' planning and building and about 100 million dollars were required to bring a water supply for San Francisco from Hetch Hetchy Valley in the high Sierras, more than 160 miles away. The O'Shaughnessy Dam is part of the system. An $8\frac{1}{4}$-mile bridge, the longest in the world, was opened to Berkeley and Oakland in 1936. The famous Golden Gate Bridge, with the world's longest clear span, was finished in 1937 (*see* Bridge). In 1945 the city was host to the United Nations Conference on International Organization, known as the San Francisco Conference. Here delegates wrote the charter of the United Nations.

SAN JOSE (*săn hō-zā'*), CALIF. Fruit packing and canning are San Jose's principal industries. The city lies in the fertile Santa Clara Valley, which produces large quantities of prunes, apricots, and other fruits. Other city products are packing-plant machinery, aluminum foil, cement, chemicals, and wire specialties.

The city's two rivers, dry except in early spring, flow through eight miles of marshy lowlands into the lower end of San Francisco Bay. To the city's east, bare, brown foothills rise into Mount Hamilton, atop which is Lick Observatory. To the west rises the forest-covered Coast Range. Because the mountains trap the rain clouds, San Jose has no rain during the summer months. A central park contains a large auditorium and other city buildings. The San Jose State College, opened in 1862 as California's first teachers' college, owns the home in which Edwin Markham wrote 'The Man with the Hoe'. Other points of interest are Rosicrucian Park, the Municipal Rose Garden—where more than 3,000 varieties bloom—and Alum Rock Park, a recreational area a few miles east of the city.

San Jose was settled by Mexicans of Spanish descent in 1777. It became the center of a stock-raising district. During the gold rush days it was a supply center for the fields in the Sierra Nevada foothills and, for a brief period, the state capital. Prunes and apricots were successfully planted soon after the Civil War. The San Jose government is the city-manager form. (*See also* California.) Population (1950 census), 95,280 (1952 special census, 102,148).

SAN MARTÍN, JOSÉ FRANCISCO DE (1778–1850). One of the greatest heroes of South American independence was José de San Martín. He helped liberate Argentina, Chile, and Peru from Spanish rule. At the height of success he relinquished his power to Simón Bolívar.

San Martín was born in northern Argentina. His father, a Spanish army captain, managed an Indian settlement there. Captain San Martín was ordered to return to Spain; there he entered his son in a Madrid school. When he was only 11 years old, José became a cadet. He was 13 when he fought his first battle in North Africa. For the next 20 years he fought both the Moors and Napoleon's forces. He rose to the rank of colonel.

Always his sympathies were with the badly treated colonials. In 1812 he resigned and returned to Argentina to join the revolt there. He married Doña Remedios Escalada, daughter of a wealthy revolutionist and threw himself into the fight. Buenos Aires was already free, and the insurgents wanted to drive the Spanish from Chile and Peru. San Martín conceived a brilliant long-range plan. In 1814 he had himself made governor of a district in the foothills of the Andes. There he slowly gathered an army and over a period of three years intensively trained it for battle. When his men were ready, San Martín led them over the high Andes into Chile. His army routed the Spanish at Chacabuca (1817) and entered Santiago unopposed. San Martín's decisive victory at Maipú the next year set all Chile free.

From Chile San Martín launched his drive on Peru. The Chilean navy, under Lord Cochrane, an able British naval officer, harassed the Peruvian coast until San Martín's new forces were trained and equipped. In 1820 his army landed on the south coast of Peru and made its way slowly north, gathering in many Spanish deserters on the way. It entered Lima in 1821, although outlying Spanish forces were still strong. After meeting with Simón Bolívar at Guayaquil in July 1822, San Martín turned over the command to him (*see* Bolívar).

San Martín's wife had died. He sailed for Europe with his small daughter. The remainder of his life was spent in Belgium and France, living on the uncertain pensions voted him by the liberated South American nations. He died Aug. 17, 1850.

SANTA CLAUS. In a snowy house at the North Pole, they say, lives a merry old gentleman with curling white whiskers and twinkly eyes. His name is Santa Claus, and his friends are the children. For weeks and weeks they look forward to his visit on Christmas Eve. On that night, while they sleep, he will whisk up in his sleigh and clamber down chimneys to leave them gifts—and whisper, "Merry Christmas, and good night to all!"

Santa brings the same bustling good cheer to children in many lands even though they know him by different names. English children call him Father Christmas. French youngsters say Père Noël. In Germany he is Kriss Kringle—from the German word *Christkindle*, or "Christ Child." Dutch children call him San Nicolaas, or Sankt Klaus. From those names come the American children's Santa Claus and St. Nicholas. (*See also* Christmas.)

Santa and His Reindeer

To honor this merry gentleman in whom children take such delight, Clement C. Moore, a noted Biblical scholar, wrote 'A Visit from St. Nicholas' in 1822. He began his verses with " 'Twas the night before Christmas" and then wrote that he saw St. Nicholas riding in a sleigh drawn by "eight tiny reindeer." As Moore watched, he heard Santa hurry them on, calling—

Now, Dasher! now, Dancer! now, Prancer and Vixen!
On, Comet! on, Cupid! on, Donder and Blitzen!

Thomas Nast, one of America's most famous cartoonists, drew the first picture to resemble the Santa Claus of today. It appeared in *Harper's Weekly* in

"RIGHT JOLLY OLD ELF"

Clement C. Moore wrote of the beloved figure of Santa Claus, "His cheeks were like roses, his nose like a cherry!"

"Happy Christmas to all, and to all a good night!" called Santa, as Moore wrote in 'A Visit from St. Nicholas'. Here "eight tiny reindeer" carry Santa to the next house.

FROM THE VILLAGE OF SANTA CLAUS

Some children write to Santa at the North Pole; others to Santa Claus, Ind. The tiny village in Spencer County handles nearly 4 million pieces of mail every year.

1866. Many children write to Santa at the North Pole; but others send their letters to him at Santa Claus, Ind., where the American Legion and civic groups answer the enormous mail and try to take care of youngsters who are in real need.

The Spirit of Generosity

Many years ago Santa's kindly spirit inspired a memorable editorial by F. P. Church in the *New York Sun*, Sept. 21, 1897. An eight-year-old child, Virginia O'Hanlon, had written to ask the newspaper, "Is there a Santa Claus?" Church answered: "Yes, Virginia, there is a Santa Claus. He exists as certainly as love and generosity and devotion exist. . . . He lives, and he lives forever. A thousand years from now . . . nay ten times ten thousand years from now, he will continue to make glad the heart of childhood."

Santa's History Begins in Turkey

The idea of a kindly man bringing presents to children at Christmas apparently goes back to St. Nicholas in the fourth century. When only a boy he was made bishop of Myra in southwest Turkey and became the patron of children. Generous, wealthy St. Nicholas is said to have secretly given three bags of gold to the daughters of a poor nobleman who could not afford to provide dowries for them.

Today in the Netherlands, Belgium, Switzerland, Austria, and parts of Germany he comes yearly on St. Nicholas Eve, December 5, to ask about children's behavior. He then returns and leaves gifts for the good children to find on December 6, and switches for bad children. In some countries St. Nicholas comes in the daytime; in some, in the stillness of the night.

In some lands he drives a horse and cart; in others, he rides a horse or donkey, sometimes accompanied by a colored helper. In Scandinavia good St. Nick hurries across the snow in a sleigh drawn by fleet, faithful reindeer.

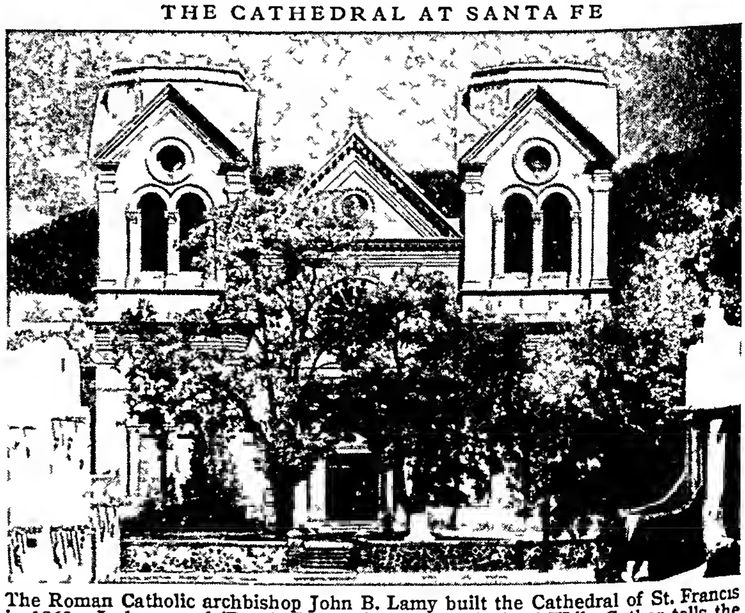
SANTA FE, N. M. Since its founding in 1609 Santa Fe has been a capital of territories under Spain, Mexico, and the United States. It is now the capital of the state of New Mexico. The city lies about 7,000 feet above sea level, with the Sangre de Cristo Mountains to its east, the Sandia Mountains to its south, and the Jemez Range to its west. The Santa Fe River breaks through the Sangre de Cristo Mountains, flows westward through the city, and empties into the Rio Grande.

Brown adobe buildings, after the Spanish-Pueblo Indian style, are plentiful. The Governor's Palace, on the north side of the central plaza, was begun in 1610; it is now the state historical museum and headquarters for the Archeological Institute of America On the plaza's southeast is La Fonda, a modern hotel on the site of an old adobe that marked the westward end of the Santa Fe Trail. Other points of interest are the Capitol, erected in 1900; the Santa Rosario Church, begun in 1692; the Cathedral of St. Francis, erected by Archbishop John B. Lamy, the hero of Willa Cather's famous novel 'Death Comes for the Archbishop'; the state penitentiary; a state school for the deaf; and the Roman Catholic St. Michael's College. (*See also* Far West; Indians, American; New Mexico; United States History.)

Santa Fe's workers are employed in state and federal offices and institutions and in hotels, stores, and restaurants that cater to a large vacation trade. Nearby are numerous Indian ruins, dude ranches, and ski runs. Since about 1900 Santa Fe has attracted many writers, artists, and musicians as residents.

During the winter of 1609–10, Don Pedro de Peralta, accompanied by Franciscan missionaries, established *La Villa Real de la Santa Fé de San Francisco* (the royal city of the holy faith of St. Francis) on the ancient ruins of an Indian village. The settlement

THE CATHEDRAL AT SANTA FE



The Roman Catholic archbishop John B. Lamy built the Cathedral of St. Francis in 1869. In her novel 'Death Comes for the Archbishop' Willa Cather tells the inspiring story of this famous priest.

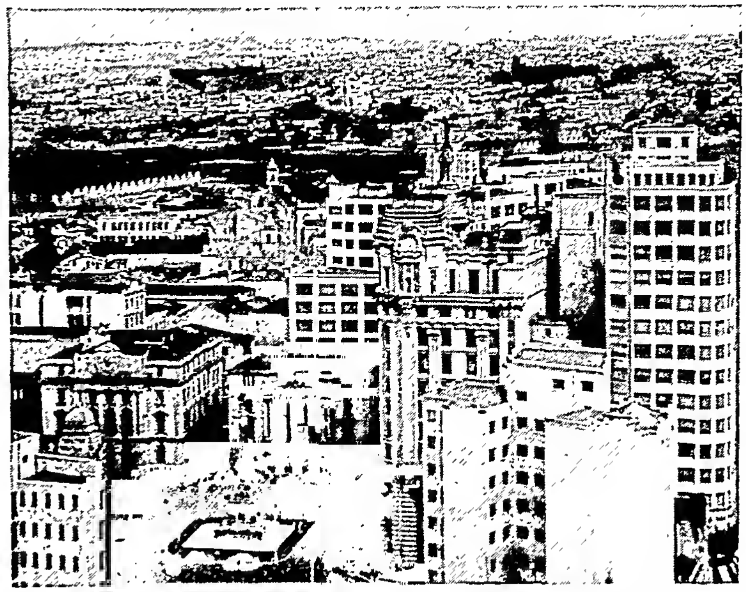
was to rule a vast area of Spanish claim, extending from the Mississippi to the Pacific and to unexplored regions north.

Despite their conversion to Christianity, the Indians rebelled in 1680 and drove the Spaniards out. The Spaniards did not return until 1692, when a bloodless re-entrance was made under Don Diego de Vargas. Some 60 Spanish governors ruled from the Palace before Mexico won its independence in 1821. In 1846, during the Mexican War, Santa Fe was occupied for the United States by Gen. Stephen W. Kearny. Except for two weeks of Confederate occupation in 1862, Santa Fe has been a part of the United States since the Mexican War. The largest of Santa Fe's many fetes is a three-day fiesta during September. The government is the mayor-council form. Population (1950 census), 27,998.

SANTIAGO (*săn-tĭ-ä'gō*), **CHILE.** Chile's capital and largest city is beautifully situated on a plain threaded by the Mapocho River on the western slope of South America. Mountains surround it, and in its center rises rocky Santa Lucia hill, the city's picturesque playground. Chief of Santiago's broad, straight streets is 325-foot-wide, poplar-lined Avenida Bernardo O'Higgins, popularly called the "Alameda." A promenade dotted with lines of statues is in the center of the Alameda, and driveways a hundred feet wide lie on either side. Along the Alameda rise magnificent Spanish-style residences with patios (courts) containing fountains and flowers.

Santiago is also the social and educational capital of Chile; it has the University of Chile and several professional schools. The rainfall is scanty, and parks in and near the city are irrigated. Numerous earthquakes have shaken the city. Airlines connect Santiago with South, Central, and North American points. An electric railroad runs to Valparaiso, Chile's chief port. The Transandine railroad links the city to Buenos Aires. Population (1952 census), 1,348,283.

THE WORLD'S GREATEST COFFEE MARKET



This picture shows the heart of the business section of São Paulo. In the center of the square stands a monument commemorating the founding of the city. A manufacturing suburb, Braz, can be seen in the background.

SÃO PAULO (*soun pou'lo*), **BRAZIL.** The Brazilian city of São Paulo appears a lovely white under the tropic sun. It lies on a plateau of the Serra do Mar, 2,600 feet above sea level, about 210 miles southwest of Rio de Janeiro. The city is the capital of the state of São Paulo. São Paulo's port, Santos, squats in sea-level heat 33 miles—50 steep and twisting miles by rail—to the southeast. São Paulo's highland climate is bracing. The temperature averages 57.9° F. for the coolest season and 69.3° F. for the warmest.

Luxuriant tropical parks and gardens and broad, palm-lined avenues beautify the city. Well-planned residential sections spread over its red hills. Skyscrapers have sprung up over a wide area, as the business district has expanded beyond its former center, the Triangle. The public library is 20 stories high; the municipal stadium seats 80,000 persons; the municipal theater is one of the world's finest. Among other points of interest are the Ypiranga Museum and the huge independence monument in an adjoining park, where in 1822 Dom Pedro, the prince regent, declared Brazil independent of Portugal. The snake farm at Butantan raises poisonous snakes of many kinds. From them venom is collected for making antisnakebite serums. It is estimated that 5,000 Brazilian lives alone are saved every year by these serums.

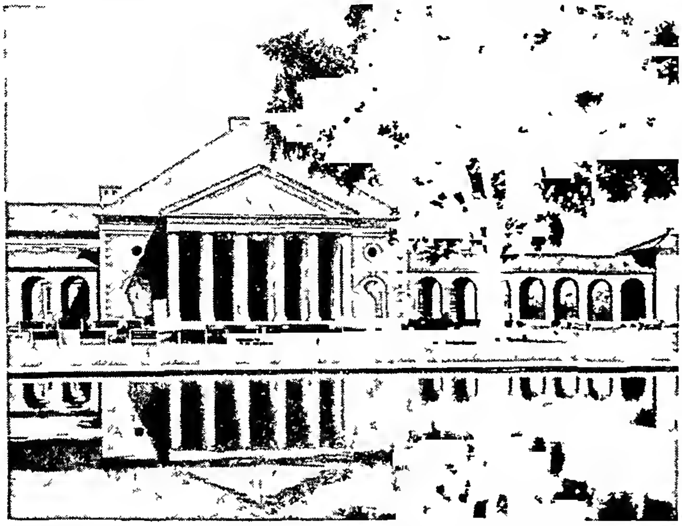
At the center of the richest coffee-growing area in the world, São Paulo has become one of the chief industrial and commercial cities of South America. Mountain rivers provide abundant hydroelectric power, and a rail network brings in raw materials. Manufactures include textiles, machinery, chemicals, leather and shoes, rubber products, paper, lumber and furniture, clothing, glass, and ceramics. Many United States firms have plants here.

São Paulo was founded by the Jesuits in 1554. For centuries it remained little more than a colonial town. In 1890 its population was 64,943. By 1940, however, its people numbered 1,258,482. Population (1950 census, preliminary), 2,041,716.

SARATOGA SPRINGS, N. Y. Sparkling springs of mineral waters and the beauty of its natural setting make Saratoga Springs a famous health and pleasure resort. It lies 30 miles north of Albany in the wooded foothills of the Adirondack Mountains.

So beneficial are its waters that in colonial days people risked wilderness travel to drink them. In 1912 the principal springs became the nucleus of Saratoga Spa, an institution operated as a part of the state public health service. More than 3,500 persons may be treated daily in the three mineral bathhouses. A hotel, a research laboratory, a Hall of Springs, a recreation unit, a new bathhouse, and a bottling plant were built by the state in 1935. The waters are shipped to all parts of the world.

THE RESEARCH INSTITUTE AT SARATOGA SPA



The Simon Baruch Research Institute is one of a group of new buildings completed by the state in 1935 at a cost of $8,500,000. They stand in a landscaped tract of 140 acres, shaded by magnificent elm trees.

Catering to visitors is the chief industry of the spacious old city. Government is by the commission plan. Skidmore College for women and Yaddo, a retreat for artists and writers, are within the city. The August horse races have been a national social event since 1864. Population (1950 census), 15,473.

The Battles of Saratoga

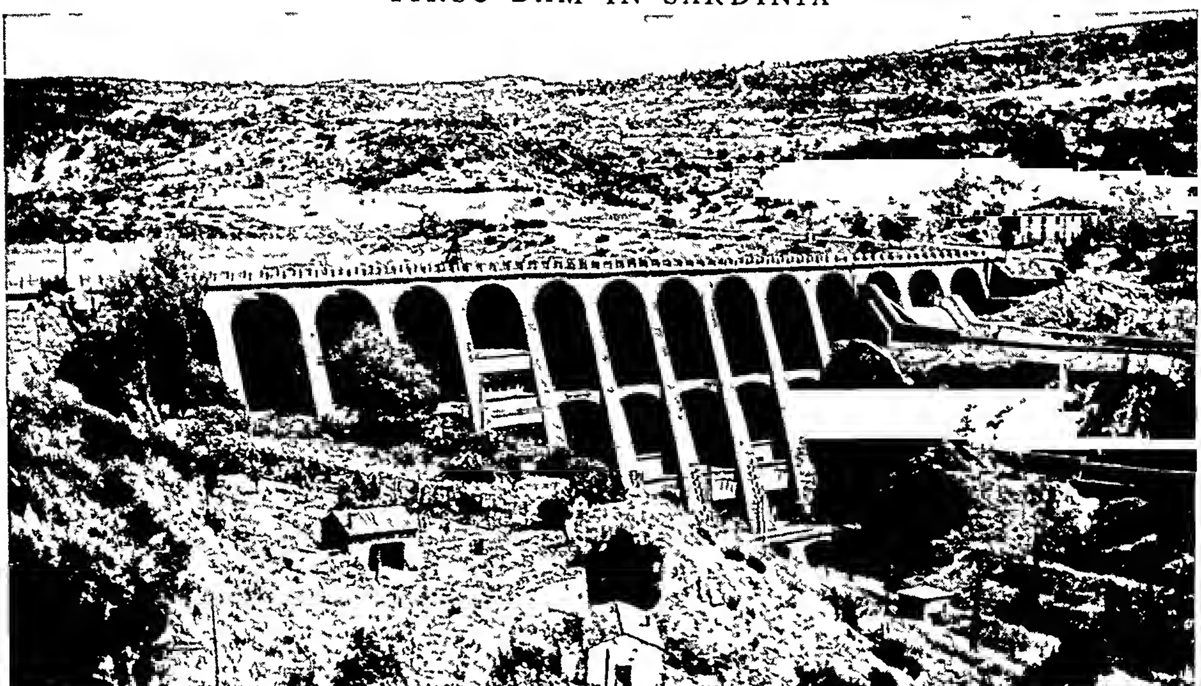
About 17 miles east of the city is the sprawling site of the battles of Saratoga, now a national historical park. Here in September 1777 Gen. Horatio Gates entrenched his Americans on Bemis Heights, near Stillwater. On September 19 the British, under Gen. John Burgoyne, advanced to attack but were blocked at Freeman's Farm by a fierce assault led by Gen. Benedict Arnold and Col. Daniel Morgan. Burgoyne attacked once more on October 7, but Arnold again rallied the Americans and forced Burgoyne to retreat to Saratoga Heights. Cut off from all sources of supply, he surrendered on October 17. This was the turning point of the Revolutionary War and hence has been ranked among the most decisive battles of the world. (*See also* Revolution, American.)

SARDINES. The canned fish known as sardines are not a distinct species of fish but the young of the pilchard, a member of the herring family. California, or Pacific, sardines belong to the species *Sardinops caerulla*. European sardines, canned in freshly pressed olive oil, command a higher price than the California product. They belong to the species *Clupea pilchardus*. The young of herring and menhaden are also canned and sold as sardines. The name comes from the island of Sardinia, where the fish were first caught in large numbers. (*See also* Pilchard.)

SARDINIA. The island of Sardinia in the western Mediterranean is a steppingstone between Europe and Africa. Tunisia is 120 miles south, France 170 miles north, and Italy, to which the island belongs, 120 miles east. Corsica is only eight miles off the north coast, across the Strait of Bonifacio.

From the invasion of the Phoenicians, a thousand years before Christ, to the invasion of the Allies in

TIRSO DAM IN SARDINIA



Tirso Dam, 230 feet high, backs up an artificial lake 13 miles long into the rocky countryside and provides badly needed irrigation water. The power plant is one of the largest in all Italy. The Tirso River is Sardinia's longest—only 94 miles.

the second World War, it has taken part in a constant drama of war and conquest. It is a poor island, about the size of New Hampshire, with an area of 9,299 square miles. It supports a population of only 1,273,714 (1951 census, preliminary).

Mountains cover much of its surface, and farmland is limited. The climate is severe, with hot, dry summers parched with winds from Africa, and cold, wet winters.

The east side of the island is a mountainous wall rising to 6,000 feet in Mount Gennargentu, the highest point in Sardinia. In the hills shepherds tend flocks of sheep, cattle, and goats. Cork forests in the northeast provide the people with a meager livelihood making bottle stoppers. There are silver mines in the southeast.

AT WORK IN A COLORFUL SARDINIAN FARM HOME

The young women are sifting meal through hand-woven sieves. The patio, with fruit trees and wandering fowl, is typical of Sardinian country homes. The women still wear the native dress.

Western Sardinia Most Prosperous

Western Sardinia has most of the towns, farms, mines, and roads. Here are high tablelands with fertile soil from scattered extinct volcanoes. The Campidano Plain, 15 miles wide and 60 miles long, runs from the Gulf of Oristano, on the west, across the island to the city of Cagliari, which is on the extreme southeast. This plain has provided wheat from Roman times until the present. It also produces vegetables and fruits.

Another fertile plain in the northwest curves around the city of Sassari. Olive and orange trees, and vineyards are grown in this section. The Tirso is the only important river. It empties into the Gulf of Oristano. The Tirso Dam and power plant are among the largest in Italy.

In the southwest are mines of iron, zinc, lead, copper, silver, manganese, and antimony. New coal fields were opened up just before the second World War. Tunny, lobster, and sardine fisheries are a source of income.

The island is divided into two provinces, named for their capital cities of Cagliari and Sassari. Cagliari, on the south coast, is the largest city (population, 137,040) and chief port. Its site has been occupied since the days of the Phoenicians, who called it Caralis. The modern town lies on the low land along the sea. Above, on a mountain ridge, is the citadel whose walls are nearly a thousand years old. Near the city is a Roman amphitheater. A university and a library noted for its ancient manuscripts are places of interest. Sassari, on the northwest, is the second largest city (population, 70,324, includes suburbs). Iglesias is the center of the southwest mining district.

History Dates from Bronze Age

The Sardinians are believed to be descendants of an ancient Mediterranean race, whose stone forts covered the island during the Bronze Age. In the 5th century B.C. it was conquered by the Carthaginians. In 238 B.C. it became a Roman province, and for 700 years was one of the leading sources of the Roman grain supply. In the Middle Ages the island was the scene of fierce struggles between Saracen invaders and the fleets of Pisa and Genoa. In the 14th century the king of Aragon won it, and it remained Spanish until the War of the Spanish Succession transferred it to Austria in 1713. In 1720 Austria forced the Duke of Savoy to take it in exchange for Sicily. The island then gave its name to the newly formed "kingdom of Sardinia," which included the territories of Savoy and Piedmont. This kingdom became the nucleus of modern Italy in 1861 (*see* Italy).

During the second World War the island was a base for Axis planes protecting sea routes between Italy and Tunisia. It was heavily bombed by the Allies in 1943 and was occupied by Allied troops.

SARGENT, JOHN SINGER (1856–1925). The spirit and training of many lands combined to make John Singer Sargent a famous painter. He was born in Italy of American parents, spoke his first words in German, received his art education in France, found fame in England, and made only brief visits to America. However, when asked why he did not become a British subject, since he spent most of his life in England, he replied that he preferred to remain a citizen of the United States.

Though regarded as a portrait artist, he is chiefly known in America as the man who painted the famous decorations in the Boston Public Library. On the walls of its great hallway, which now bears his name, appear the figures of the Jewish and Christian religions. They form part of a general scheme depicting the "Pageant of Religion." The splendor of the arrangement on the wall space rivals in many ways the work of the great wall painters of the Renaissance. The Hebrew prophets are perhaps the best known of the groups. These murals, begun in 1890, were not completed until 1917. (For illustration of one of the groups, *see* Prophets.)

JOHN S. SARGENT

Sargent was called the painter of the "inner face."

Sargent's portraits were among the most celebrated of their day. With masterly technique he combined a marvelous skill in picturing the mind and soul of his subject. Whatever he saw, whether pleasant or unpleasant, was put into the finished portrait. For this reason he was often called a "dangerous" painter for those who had anything to conceal. As was said of Stuart, another great American portraitist, Sargent painted the "inner face." There is a legend that a doctor, puzzled by a certain case, found the secret of his patient's baffling personal nature revealed in a portrait done by Sargent.

Among the notable portraits by Sargent are those of Theodore Roosevelt, Joseph Jefferson the actor, and Ellen Terry the actress, as Lady Macbeth. His best figure pieces include 'Carnation Lily, Lily Rose,' in the Tate Gallery, London; 'Carmencita,' Luxembourg, Paris; and 'Gitania,' Metropolitan Museum, New York City. 'The Fountain' and 'Trout Stream in the Tyrol' are in the Chicago Art Institute.

SARSAPARILLA. This drug from tropical America is commonly known only as a flavor in carbonated drinks. Its chief use, however, is as a syrup medium in which medicines are given.

Sarsaparilla comes from the dried roots of several species of *Smilax*, which grow in Mexico, Jamaica, and the tropical areas of Central and South America. The plants are climbing shrubs with prickly stems. The Spanish gave it the descriptive name of little (*illa*) bramble (*zarza*) vine (*parra*). The slender, creeping roots radiate for about nine feet from the underground rootlike stem. Only the larger roots are cut. The earth has to be scraped away and other roots disentangled carefully to avoid injuring the plant. Then the earth has to be replaced about its base. The drug is extracted by boiling the dried roots in water or alcohol.

Sarsaparilla roots were taken from the New World to Europe as early as the 16th century. For many years the extract was used in the treatment of a variety of diseases. Today its only medicinal property is believed to be its ability to increase the absorption of other drugs by the intestinal tract.

The two principal species are *Smilax officinalis*, from Jamaica, and *Smilax medica*, from Mexico. The wild sarsaparilla, or false sarsaparilla of the eastern United States and Canada, is a nearly stemless woodland herb, *Aralia nudicaulis*.

SASKATCHEWAN—*A Land of* FERTILE *Fields*

Extent.—North to south, 761 miles; east to west, 277 to 393 miles; area, 251,700 square miles. Population (1951 census), 831,728.

Natural Features.—Bounded north and south by 60th and 49th parallels; on the west, by 110th meridian. Rolling country, rising in west and broken by low hills; southern prairies separated from northern forests by a parkland. Highest point, Cypress Hills, 4,546 feet; lowest, Lake Athabaska, 695 feet. Athabaska, Reindeer, Wollaston, La Ronge, Cree, Peter Pond, and many smaller lakes. Chief rivers: Qu'Appelle, Saskatchewan, and Churchill.

Products.—Wheat, oats, barley, milk, cattle, eggs, rye, flaxseed, poultry, hay and clover, alfalfa, potatoes; petroleum products; flour, meat, butter and cheese, brewery and bakery products, copper, zinc, coal, gold, sodium sulfate, lumber; fur; fish.

Cities.—Regina (capital, 71,319), Saskatoon (53,268), Moose Jaw (24,355), Prince Albert (17,149), North Battleford (7,473), Swift Current (7,458), Weyburn (7,148), Yorkton (7,074).

SASKATCHEWAN. Wheat, co-operatives, and a socialistic government have made Saskatchewan famous. This is the middle one of Canada's three prairie provinces. Alberta borders it on the west, Manitoba on the east. Southward its grain fields and grazing lands merge into those of North Dakota and Montana. On the north lie the Northwest Territories. Saskatchewan's area of 251,700 square miles makes it almost as large as Texas. It is a varied land of southern plains, central parkland, and northern forests stretching to the treeless tundra.

The Southern Plains

The open grassy plains extend about 75 miles north of the United States along the Manitoba boundary to the east, then run northwest to a point about 200 miles north of the United States on the Alberta boundary. These vast fields produce one-half of Canada's wheat. The farm buildings seem like islands in a sea of golden grain. Cottonwoods grow along the stream beds, and cottonwoods and cypresses are planted as windbreaks around the buildings.

The plains are broken in the southwest by the Cypress Hills, and in the southeast by Moose Mountain. Both are hilly, wooded regions which have been made provincial parks. The plains slope from 1,500 feet above sea level on the Manitoba border to about 3,000 feet on the Alberta border. Cypress Hills is the highest point (4,546 feet).

Central Parkland

North of the plains is a strip of parkland about 125 miles wide. This is a rolling prairie, broken by groves of poplar and willow. There are wooded hills, and tree-girdled ponds and marshes where ducks, geese, and other water birds nest in the summer. Parkland farmers do not depend for their livelihood on a single

crop, as the wheat farmers do. The average farm is smaller than on the plains, and mixed farming, stock-raising, and dairying are practised. Regina and Saskatoon are the two largest cities in the province. They lie on the indefinite borderline between the plains and park regions.

Northern Forests

Beyond the parkland, between the Saskatchewan and Churchill rivers, lie enormous forests. Commercial lumbering is the chief occupation. Prince Albert is the gateway to this region and to Prince Albert National Park (*see* National Parks).

The Laurentian Plateau starts north of a line beginning near Flin Flon on the Manitoba border, and extends west to Lake Churchill. Here the land is underlaid by ancient precambrian rocks and threaded with countless streams and lakes (*see* Laurentian Plateau). The forests are thin, and fur trapping and fishing are the chief occupations of the few inhabitants. The extreme northeastern corner of the province lies in the "Land of Little Sticks," a sub-Arctic forest of stunted trees and spongy, moss-covered muskeg.

Rivers in the northwest corner drain to the Arctic Ocean. All other important rivers reach Hudson Bay. In the south are the Souris, Qu'Appelle, and Assiniboine. The Saskatchewan, and its principal tributary, the South Saskatchewan, drain the parkland and southern forest regions. The Churchill is the largest river in the north. The largest lakes are Athabaska, Reindeer, Wollaston, La Ronge, Cree, Peter Pond, Doré, Quill, and Churchill.

A Climate of Extremes

The continental type of climate prevails. The January average temperature varies from 10 degrees above zero in the southwest to 23 degrees below zero in the northeast. The July average is 57° in the north and 67° in the south. Extremes of 113 degrees above zero and 70 below have been recorded.

The long, hot summers on the plains are ideal for ripening grain quickly. The heaviest rains usually fall during June and early July, when they are most needed by the growing crops. But the strong winds that blow across the open prairies evaporate moisture rapidly. Occasional droughts damage and sometimes destroy the wheat crop. In the parkland the effective precipitation is greater and the winds less severe.

Farming the Leading Industry

About one half of the people of Saskatchewan depend directly upon agriculture for a living. Some two thirds of its people live in rural communities. This province raises half of Canada's spring wheat. It is also the leading producer of oats and rye. Other important field crops are barley, flax, hay and clover, and alfalfa. In the central parklands beef and dairy cattle, sheep, and hogs are raised. Large quantities of eggs and poultry are also produced.

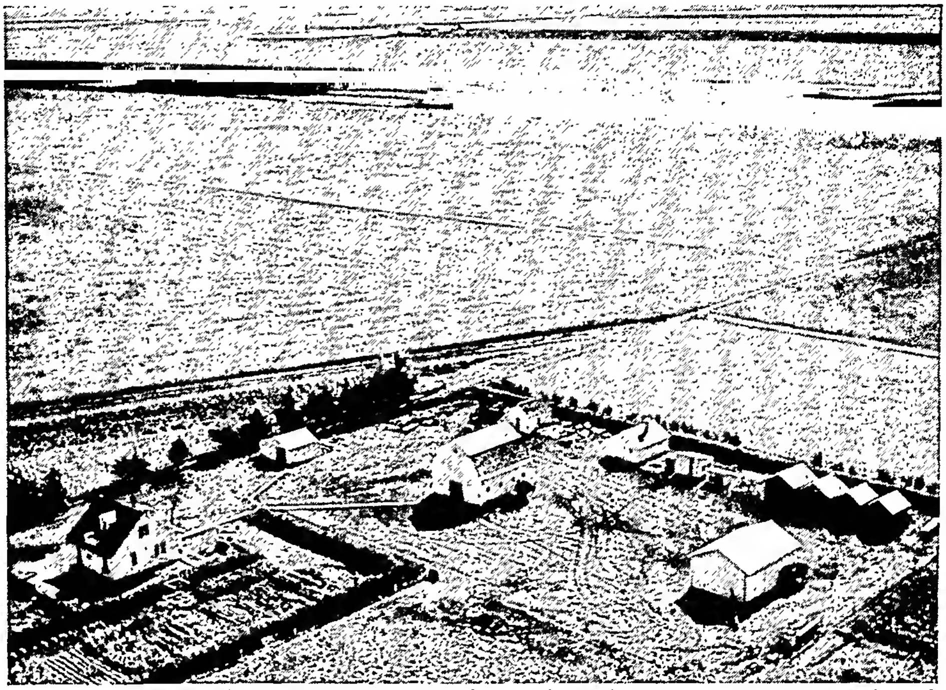
Saskatchewan farmers have always coöperated in an effort to minimize the hazards of wheat growing and to improve their marketing position. The first important farm organization was the Territorial Grain Growers' Association, formed in 1901. Out of it grew the Saskatchewan Coöperative Wheat Producers, Ltd., which markets most of the wheat crop. Other coöperatives deal in eggs and poultry, dairy products, and wool.

State aid to agriculture has been provided for many years. A recent example is the Agricultural Representative Act of 1945, which coördinates the extension work and research findings of the Provincial and Dominion departments of agriculture and the University of Saskatchewan. The province is divided into 36 districts, each with one agricultural representative, who is a member of the Saskatchewan Institute of Agrologists. He works with local committees and district boards to put into operation the government's long-term programs for crop diversification, conservation, and reclamation.

Trapping, Fishing, and Lumbering

Fur-bearing animals are still abundant in the great northern forests and in the marshes of the central and southern sections. Muskrat and beaver are the most valuable of the wild animals. Fox and mink are raised on fur farms. The provincial government licenses trappers and controls the number of animals they may take in a season. The pelts are marketed

THE TREELESS PRAIRIES FROM THE AIR



This air view of a Saskatchewan wheat farm gives an idea of the apparently endless miles of flat prairie land. The trees around the buildings were planted as windbreaks.

for the trappers by the Saskatchewan Fur Marketing Service, a government-owned corporation.

Commercial fishing is largely a winter industry of the northern lakes and streams. Whitefish represent more than half the total catch.

One-third of the total land area is forested. Spruce, jackpine, poplar, and tamarack are the chief commercial species. All timber from crown lands is marketed by the Saskatchewan Timber Board.

Wealth from Minerals

Copper is first in value of the province's mineral output. From the important Flin Flon ore bodies, shared with Manitoba, come gold, copper, zinc, and silver. New oil reserves were discovered in 1953. Drilling increased almost 100 per cent in that year.

On the north shore of Lake Athabaska are large deposits of gold, and pitchblende, which is an ore of uranium and radium. Other areas in the far north await development. Lignite coal is found over a large part of the prairies. The Souris River area is the chief producer. Lloydminster on the Alberta boundary is the center of petroleum and natural gas production. On the prairies are many deposits of sodium sulfate.

Government in Business

The leading industries are based on the agricultural resources—slaughtering and meat packing, flour milling, butter and cheese making, and manufacture of brewery and bakery products. Petroleum refining and sawmills are major sources of income. These industries, as well as wholesale and retail trade, are controlled by private enterprise and co-operative organizations. Printing and publishing are also important.

When the Cooperative Commonwealth Federation party came into office in 1944 it socialized many public services and entered into several manufacturing fields which had not attracted private capital. It operates a brick and tile plant and a sodium sulphate plant. It also mines and markets the clay products of the province. It has its own insurance agency, printing plant, and housing corporation. Automobile accident insurance is compulsory. Electric power, telephones, and bus transportation are government owned. The Government Airways operates the province's northern air services.

Education and Social Welfare

Education is free and compulsory. The Larger School Unit Act of 1944 provided that some 5,000 rural school units be replaced by 60 larger units. The provincial government assumes a greater share of educational costs, and the basis of local taxation for education was broadened. Today land not included in any organized school district may be taxed for education purposes. The larger unit system made possible more efficient administration and expansion of services. The University of Saskatchewan, founded in 1907, is located in Saskatoon. There are normal schools in Saskatoon and in Moose Jaw.

Under the provisions of the Health Services Act of 1946, a number of health districts were established which provide the people living in them with free public health services, and personal health service on

DAIRY PRODUCTS AND COAL

Dairy products are sold through coöperative marketing associations (top). The coal mines around Estevan, near the United States border, are the largest in the province (bottom).

a prepayment basis. Hospital insurance is compulsory for all residents of the province. Provincial grants help local communities to build new hospitals. There are free cancer and mental hygiene clinics, and treatment and hospitalization of tuberculosis is free of charge. An air ambulance service for the remote parts of the province is operated by the Department of Public Health.

Saskatchewan is governed by a legislative assembly elected by the people every five years. The lieutenant-governor is appointed by the governor-general of Canada for five years, but the actual executive head is the premier, who is the leader of the dominant political party.

From Fur Trading to State Socialism

The name of the province is the Cree Indian word for "rapid river." In 1774 Samuel Hearne, a trader and explorer for the Hudson's Bay Company, built Cumberland House, a fur-trading post on Lake Cumberland. One hundred years later, in 1875, the Royal Canadian Mounted Police built Fort Walsh in the

Cypress Hills to control Indians and "wolvers," lawless bands of white men from the United States.

In the 1880's new railroads started bringing settlers, and the immigration continued until World War I. The first families came from eastern Canada and the United States. They were followed by German Mennonites, Dukhobors from Russia, Ukrainians, Magyars from Hungary, French, and Scandinavians. In 1882 the country of which Saskatchewan was a part was organized into four provincial districts. These were reorganized in 1905 to form the provinces of Saskatchewan and Alberta. Population grew to 921,785 in 1931 but fell to 831,728 by 1951. Two fifths of the people are of British origin.

During the drought and depression of the 1930's, Saskatchewan sought relief in political and economic experimentation. The Saskatchewan and Alberta sections of the United Farmers of Canada and the Independent Labor party formed a national party, the Co-operative Commonwealth Federation (C.C.F.). It united labor and agriculture on a program of state socialism. It became the nation's third strongest party. In 1944 it gained control of Saskatchewan's legislature and was re-elected in 1949 and 1952.

After World War II production of minerals, particularly uranium, oil, and natural gas, increased. In 1953 new uranium deposits were found in the Lac La Ronge and Beaverlodge areas. (For Reference-Outline and Bibliography, *see* Canada; Canadian History.)

SAS'SAFRAS. This wild plant is attractive at all seasons of the year. It grows from Massachusetts to Florida and westward throughout the Mississippi Valley. In the northern part of its range it is a large shrub or small tree 25 to 30 feet tall. In the south it may reach 80 feet. It often grows in dense thickets, for a single tree is soon surrounded by thriving canes sent up from its roots.

The main branches stand out almost at right angles from the trunk, with the many twigs growing upright from them. The leaves have three different patterns, all of which may appear on the same branch. They may be oval; mitten-shaped with one lobe like the thumb of a mitten; or shaped like a double mitten with a thumb on each side. The light, cool, green leaves turn to brilliant yellow, scarlet, or orange in autumn. In autumn too blue fruits with short red stems appear. Through the winter the buds remain bright green at the tips of pale green twigs. In early spring yellow-green blossoms appear in clusters.

The red-brown bark is deeply ridged, spicy, and aromatic. Sassafras tea, prepared by boiling the root bark, was once popular as a spring tonic. Oil of sassafras has been used in certain medicines, soaps, and candy. The wood is used for fence posts, cross-ties, furniture, and barrels. The tree is becoming popular as a windbreak and for restocking abandoned and eroded farm lands.

Sassafras belongs to the laurel family (*Lauraceae*). There are only three species, one in central China, another in Formosa, and the third (*Sassafras albidum*) in the United States.

SATURN. This ancient Roman deity has been identified with the Greek god Kronos, who, it was said, after his dethronement by Zeus fled to Italy and there established his reign, known as the "Golden Age" of Saturn (*see* Zeus). But the name Saturn comes from a Latin word meaning "to sow," and, unlike Kronos, he was a god of agriculture who taught his people to till the soil. He is represented with a sickle in his hand. His wife was Ops, the goddess of plenty. In honor of Saturn, a great yearly festival, called the Saturnalia, was held in December after the sowing of the winter grain was finished. This was a time of games and feasting. Presents were exchanged, including especially wax candles and dolls. Distinctions of rank were laid aside, and liberties were allowed even to slaves. It was formerly believed that the celebration of Christmas, which comes at about the same time, was introduced by the Church to displace the pagan license of the old Saturnalia.

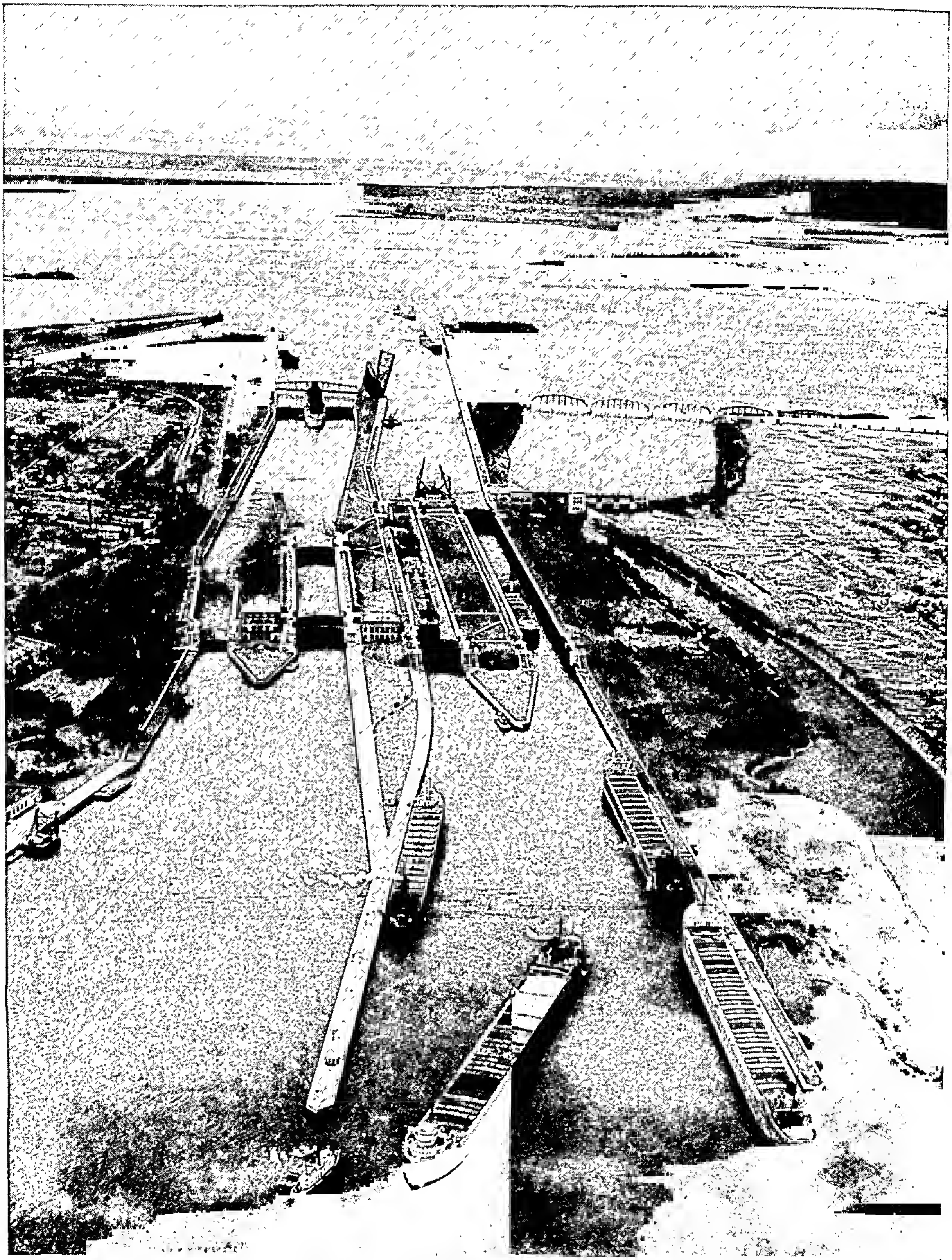
In astronomy, the planet Saturn is the sixth major planet in distance from the sun. It has a magnificent system of rings and satellites. (*See* Planets.)

SAULT SAINTE MARIE (*so̤ sānt ma̤-rē'*). Lake Superior's outlet into Lake Huron is the angry little Saint Marys River, which is 63 miles long. It flows in a southeasterly direction through the one-mile-wide channel which here separates Canada from the Upper Peninsula of Michigan. The level of Lake Huron is some distance below that of Lake Superior, and in making the descent the river drops 20 feet in a mile, forming rapids (the *Sault*, or "rapids," of Saint Mary) impassable to lake vessels. The Lake Superior region was thus barred from the seaboard until a ship canal was built around the rapids in 1855, overcoming the difference in level by means of locks. Today the Soo, as it is popularly called, has two canals: one on the north, or Canadian, side of the river, and the other on the American side.

The original American canal was completed in 1855 by the state of Michigan and transferred to the United States government in 1882. The present canal is about two miles long, but there are 30 miles of dredged channel leading to it from the Huron side with a depth of 22 feet. The canal has four locks. These range in width from 80 to 100 feet, in depth from 22 to 30 feet, and in length from 800 to 1,350 feet. A jackknife bridge, one of the largest bascule bridges in the world, spans the American canal.

Although the canal is ice free only about eight months of the year, this outlet for the ore and grain of the Northwest usually carries more cargo annually than the Panama and Suez canals combined.

On the Canadian side a canal with locks was built by the fur-trading North West Company, as early as 1798, but it was destroyed in 1814 by American troops in the War of 1812. The present Canadian canal was completed in 1895. It is $1\frac{1}{3}$ miles long and has a lock 900 feet long and 60 wide. Both canals are toll free, and vessels go through either the Canadian or the American locks, whichever is the most convenient.



This is an airplane view of the American canal and locks at Sault Sainte Marie, Mich., looking west. On the far horizon stretches Lake Superior. Its waters flow through the Saint Marys River, which leads into Lake Huron. At the right are the foaming rapids around which the canal was built. Still farther to the right, not visible, lie the Canadian canal and locks. Each of the two big locks in the center is 1,350 feet long—one of the longest in the world. The freighters usually carry more cargo through these waters than passes through the Panama Canal and the Suez Canal combined.

These two artificial links in the Great Lakes system complete the water chain or highway by which vessels can sail continuously from Duluth on Lake Superior to the Atlantic Ocean (*see* Great Lakes; Welland Ship Canal). The "Soo" carries more freight tonnage than any other canal in the world, and in most years more than the Suez and Panama canals combined, even though navigation is closed by ice for four months. Coal makes up the bulk of the westbound cargoes, and iron ore and grain most of the eastbound. About 15,000 vessels pass through the American canal in an average year, and about 5,000 use the Canadian canal. The picture opposite shows the American canal.

Two cities named Sault Sainte Marie border the canals. The principal products of the Ontario city are iron and steel, chromium, foundry and machine-shop products, chemicals, and paper. (Population, 1951 census, 32,452.) The Michigan city is connected with Canada by a railroad bridge and a ferry. Its chief manufactures are chemicals, leather, lumber, and woolen products. Both cities use the water power of the rapids to generate electricity for industrial and other purposes. Founded in 1668 by Father Marquette, Sault Sainte Marie, Mich., was the first permanent white settlement in what is now the state of Michigan. Population (1950 census), 17,912.

SAVAN'NAH, GA. Historic Savannah, 16 miles from the Atlantic on the Savannah River, is the oldest and second largest city in Georgia and one of the most beautiful in the United States. It is the state port of Georgia and a leading commercial center of the South. The city draws materials for manufacturing and export from a rich region. Savannah was one of the most famous of the old South's cotton markets. But cotton growing declined in the area after the first World War, and lumber and other pine-tree products became the chief cash crops.

The city's industries include lumber and woodworking mills, cottonseed-oil mills, paper and bag factories, a sugar refinery, a sea-food cannery, and factories making fertilizers, paperboard, gypsum, chemicals, concrete, turpentine, paints, and steel products. Four railroads and three airlines serve Savannah. The city is also the home of the Hunter Air Force Base.

The wide, tree-lined streets are intersected at regular intervals by small parks and squares. The squares were originally intended to be points of defense against Indian and Spanish attack. Now they bloom with gardenias, camellias, and azaleas. Palmettos, magnolias, and great old live oak trees hung with Spanish moss give Savannah the name "Forest City." Monuments to Revolutionary and Confederate heroes stand in many of the parks. Old brick houses with high stoops, iron railings, and half-hidden gardens add to the leisurely charm of the city.

The Telfair Academy of Arts and Sciences contains sculpture, paintings, textiles, and small art objects. Of special interest are colonial kitchens and fine old furniture. The Georgia Historical Society has a valuable collection of old books and documents. Armstrong College is controlled by the city.

Savannah was founded on Feb. 12, 1733, by Gen. James E. Oglethorpe, an English philanthropist. His aide in planning the town was Col. William Bull, a Carolina engineer for whom the main street was named. The town was headquarters for a buffer colony between Spanish Florida and Carolina.

In 1778 Savannah was captured by the British, who held it until the close of the Revolutionary War. During the Civil War it was an important Confederate supply depot. Union forces captured the city on Dec. 21, 1864. Savannah has a mayor-council government. Population (1950 census). 119.638.

SAVONAROLA
The Reformer of Florence

SAVONARO'LA, GIROLAMO (1452–1498). "Oh, my Florence! I was in a safe harbor, the life of a friar; the Lord drave my bark into the open sea. Before me on the vast ocean I see terrible tempests brewing. The wind drives me forward and the Lord forbids my return. On my right the elect of God demand my help; on my left demons and wicked men lie in ambush. I communed last night with the Lord and said, 'Pity me, Lord; lead me back to my haven.' 'It is impossible; see you not that the wind is contrary?' 'I will preach, if so I must; but why need I meddle with the government of Florence?' 'If thou wouldst make Florence a holy city thou must give her a government which favors virtue.' Then was I convinced and cried, 'Lord, I will do Thy will; but tell me, what shall be my reward?' 'My son, the servant is not above his master. The Jews made Me die on the Cross; a like lot awaits thee.' "

In burning allegorical words such as these the Dominican friar Savonarola swept the pleasure-loving people of Renaissance Florence by the tempest of his eloquence. Appalled by the sins of the world—and disappointed in love, so it is said—he had become a friar in Bologna at the age of 22. His first attempts at preaching were failures, but gradually he gained confidence and his fame spread throughout all Italy.

In 1490 Savonarola was ordered to Florence by his superiors and was elected friar of the monastery of San Marco (St. Mark's). His Lenten and Advent sermons in the cathedral of Florence, in which he denounced the sins of Florence and prophesied speedy punishment, soon gave him such a hold upon the city as few preachers have ever had.

Appeals to the Emotions of the Florentines

In imagination we can see the shrunken figure and the gaunt face of the little hooded friar, his glowing black eyes flashing like lightning from beneath the

shadow of his cowl. His prophetic words concerning the coming "scourge of God" seemed fulfilled when Charles VIII of France crossed the Alps in 1494 and invaded Italy. The emotional Florentines seized the opportunity to expel their despot, the feeble son of Lorenzo de' Medici, and restore their republic; and under the guidance of the prophetic preacher of San Marco they entered into alliance with the French.

Savonarola became practically dictator of the city and set about his task of giving Florence "a government that favors virtue." Day by day his impassioned words roused the people to greater and greater religious enthusiasm. Light-hearted pleasure-loving Florence became a city of puritans. Hymns echoed through the streets where lately had sounded riotous songs. In 1497 Savonarola sent the children from house to house to collect the "vanities" of the inhabitants. These were piled high in the public square—the fancy dresses and masks worn at the carnival, immodest books and pictures, and the like—and burned at the close of a solemn procession through the city.

But powerful enemies were now arrayed against Savonarola. The friends of the Medici were plotting their return. Pope Alexander VI ordered the zealous monk to discontinue preaching because of the Florentine alliance with France and excommunicated him. At the same time a reaction against puritanism swept over the city. A proposed ordeal by fire between a hostile monk and one of Savonarola's disciples to test the truth of Savonarola's teaching came to nothing after all arrangements were made and the people assembled.

The fickle Florentines now turned against him. His enemies gained control in the elections, the monastery of St. Mark's was stormed, and Savonarola was arrested. Through the use of torture they obtained from him whatever confessions they wished. In spite of the fact that his teachings were essentially the same as those of the church, he was condemned and burned as a heretic in 1498.

SAWFISH. The sawfish is a huge member of the ray family. It sometimes reaches 20 feet in length and a weight of more than 700 pounds. Its "saw" is a flat extension of the snout, covered with tough skin called *shagreen*. Into its two edges are set 26 pairs of long sharp teeth. The saw is often six feet long and a foot wide at the base. Normally it is used among a school of fish and is wielded with a side to side movement. The small weak mouth is set on the underside of the head, back of the eyes, as is the case with its relatives the sharks. Its front fins are horizontal, serving only to balance the fish in the water. The female gives birth to about 20 living young, instead of laying eggs as many fish do. The saw remains soft and flexible until after birth.

Many tales are told of sawfish attacking boats or bathers; but these stories are for the most part untrue and are due to confusion of this animal with the much bolder and fiercer swordfish. The sawfish fights usually for food alone and will rarely assail a creature bigger than itself. It is fairly common in the Gulf of Mexico. Sawfish will occasionally ascend rivers, and specimens have been taken from the lower Mississippi River. The scientific name of the common sawfish is *Pristis pectinatus*. (*See also* Fish; Swordfish.)

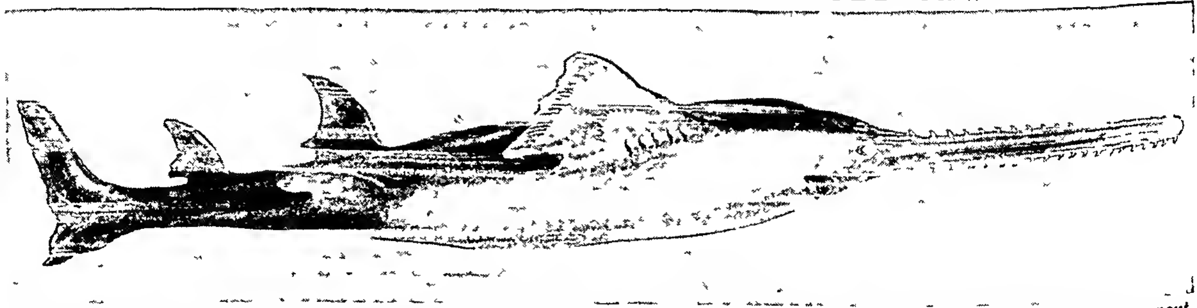
SAXIFRAGE. The name of this flower means "rock breaker" and it comes from the Latin words *saxum*, "rock," and *frangere*, "to break." It grows in tiny cracks on rock and helps to break down the rock into soil. It is native to north temperate and arctic regions.

Various kinds of saxifrage, sometimes called rockfoil, are used in rock gardens and border plantings. The family *Saxifragaceae* includes shrubs (gooseberry; currant; hydrangea; and syringa, or mock orange) and wild flowers (bishop's cap, or miterwort; alumroot; and grass-of-Parnassas).

Early saxifrage (*Saxifraga virginiensis*), found on rocks and dry hillsides, blooms in the Middle Western states from March to May. It has wedge-shaped leaves clustered in a rosette at the root. From the center of the rosette grows a fuzzy stem with a cluster of white, five-petaled flowers.

SAXONY, GERMANY. The old historic region called Saxony is one of the richest parts of all Germany. It lies in the triangular basin formed by the upper Elbe River and its tributaries. The ridges of the Erzgebirge (Ore Mountains) mark its southern limits. To the west lies Thuringia and to the east the old historic region of Silesia. The land is varied and beautiful. Small lakes glisten in the north, and

THE SAWFISH AND ITS TWO-EDGED SAW



This picture shows how the teeth on the "saw" curve backward so as to enable the sawfish to tear the flesh of its victims. The teeth of the fish fit into sockets in the sides of the bony snout, much as the teeth of land animals fit into their jaws.

there are many mineral springs. Cattle and sheep graze in rolling, tree-dotted pastures. The chief crops are rye, oats, potatoes, beets, and flax. The farmers grow many fruits, including apples, cherries, and plums. The once-rich metal mines have been worked out, but coal and ample water power supply textile factories and industries based on imported metals.

After the second World War the Allies created new "Saxonies," giving the name *Saxony* to new political units. The British, in their zone, combined the old Prussian province of Hanover and the lands of Brunswick, Oldenburg, and Schaumburg-Lippe into a new state called Lower Saxony (Niedersachsen). Hanover became the capital. In the Soviet zone of occupied Germany the Russians divided the old historic Saxony into two states, or *länder*. They were Saxony-Anhalt (Sachsen-Anhalt) and Saxony (Sachsen). In 1952, to gain tighter control, they dissolved the two states into five districts (*see* Germany).

Started Out as Pirates

When the old Saxons first appeared in history, they were redoubtable sea-pirates, ravaging the coasts of Britain and France from their homes at the base of the peninsula of Denmark. Beginning about A.D. 450, they helped to found the Anglo-Saxon kingdom of England (*see* English History).

In Charlemagne's day the parent stock still dwelt by the shores of the North Sea, from the Elbe westward to near the Rhine, and from the sea southward to the low mountains of Hesse and Thuringia. Thirty years of almost incessant warfare (772–803) were required to conquer and christianize this vigorous people and make them a part of the Frankish empire (*see* Charlemagne).

Within little over a century afterward the duke of the Saxons had become king of all Germany, and revived the Holy Roman Empire (*see* Otto, Emperors of the Holy Roman Empire). And even after the kingship and imperial power had passed to other German lines, the rulers of the stem duchy of Saxony —especially Henry the Proud and his son, Henry the Lion (died 1195), who also ruled Bavaria—were among the most formidable of German princes.

Modern Saxony Has Moved

But modern Saxony has nothing but the name in common with the old stem duchy. Its very location is different, for it lies at least 150 miles to the southeast, in a "mark" or border-land conquered by the former dukes from the Slavic Wends. After 1423 this territory and the Saxon vote in the imperial electoral college belonged to the princely house of Wettin. In 1485 the land was partitioned between two sons, from whom descended an "Ernestine" line with Wittenberg as capital and the title of elector, and an "Albertine" line, with its capital at Leipzig.

The Elector Frederick the Wise (1486–1525), who was Luther's sovereign and protector, was the head of the Ernestine line. In 1547 his successor was defeated by Duke Maurice, head of the Albertine line, who thereby obtained the title of elector together with Wittenberg and other portions of Ernestine territory. The Ernestine line was long represented by a group of petty states known as the "Saxon duchies," lying in the Thuringian region to the west of the Albertine lands.

From the latter comes our present-day Saxony. It was devastated in the Thirty Years' War, but for nearly 70 years (1697–1763) its head was also (by election) king of Poland. It suffered severely at the ruthless hands of Frederick the Great. It was raised to a kingdom and had its territory increased by Napoleon; and then was deprived of its northern half, to the gain of Prussia in 1815. It was again obliged to pay an indemnity to Prussia in 1866, but it fought on the side of Prussia in the Franco-Prussian War and became part of the German Empire in 1871. With the rest of Germany it deposed its hereditary rulers and became a republic in 1918. In 1933 it dwindled to an administrative unit in Adolf Hitler's dictatorial Third Reich. During the second World War its industrial cities were heavily damaged. (*See also* Dresden; Germany; Leipzig.)

SCALE INSECTS. Some years ago the fruit growers of California were thrown into a panic by the discovery that immense numbers of scale insects of the "cottony-cushion" species were devastating their trees, threatening the flourishing groves of citrus fruits with destruction. Spraying the thousands of acres of trees with insecticides seemed in those days a hopeless task, and ruin stared them in the face. Experts dispatched to Australia, whence the pest had accidentally been introduced, brought back with them the little red-and-black spotted Australian lady-bug, which they found was the natural enemy of this pest in its native land. When these imported beetles had multiplied sufficiently, numbers of them were sent to the fruit-growers, who liberated them in the groves. Swooping down on the feast, the beetles made quick work of the pest. By the aid of those beetles and other remedial measures, in less than two years the pest was so thoroughly controlled that it has never since got out of hand. When it was found that the lady-bugs starved to death as soon as the scale insects disappeared, colonies of them were kept going by breeding a supply of their favorite food. Now whenever there is an outbreak of scale insects, reserves of lady-bugs are in readiness.

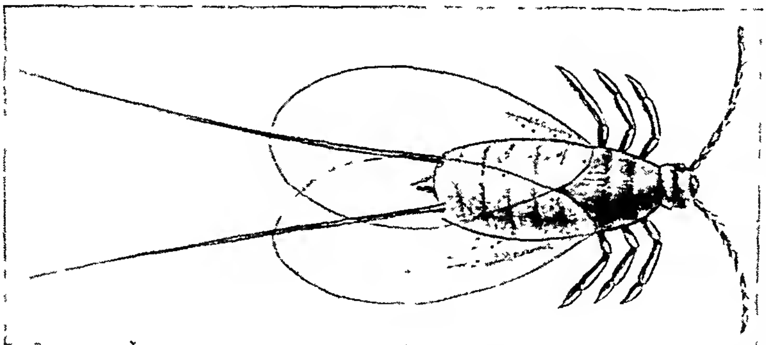
The cottony-cushion scale (*Icerya purchasi*) is only one of a number of species of the group of scale insects which are very injurious to fruit trees, shade and ornamental trees, bushes, vines, and even grasses. They may occur on any part of the stem or leaves, and sometimes even on the roots. They are called "scale insects" because they fasten themselves to a certain spot on the plant, and, with their beaks buried in the tissues of the plant, there remain feeding on the sap, protected and concealed beneath a powdery, cottony, or waxy secretion and various cast-off skins which form an oval or rounded scale.

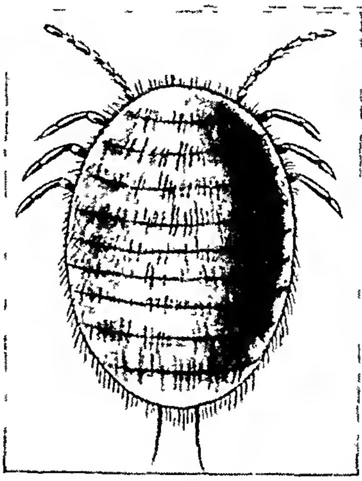
The most troublesome scale insect in the United States is the "San José scale" (*Comstockaspis perniciosa*), which is believed to have been introduced into

this country from China. By 1890 it had spread over the greater part of California and five years later was established in many parts of the United States. It is now found all over the United States, and has proved very destructive in the best fruit-growing regions. It does not bother citrus fruits, but attacks many other trees and plants, including the apple, cherry, rose, pear, currant, gooseberry, elm, chestnut, oak, walnut, and many ornamental trees and shrubs. When this pest is present the twigs are marked by a gray scaly substance. Recently a lady-bird beetle of China has been brought to this country to aid in the fight against it. The "red scale" of the orange is a close relative of the San José scale.

Another troublesome scale is the "cottony-maple," often found on many other trees as well as on the maple. Its name comes from the cottony appearance of the large egg-sac which is attached to the mother scale. The "cotton" is really a wax. The "oyster-shell scale," so named because the scale resembles the shell of some kinds of oysters, occurs frequently on apple, lilac, willow, and other trees.

THEY HELP TO TURN THINGS RED





The upper picture shows the male cochineal, the lower the female. From the dried bodies of these insects a famous red dye is made. The cochineal is one of the few useful scale insects.

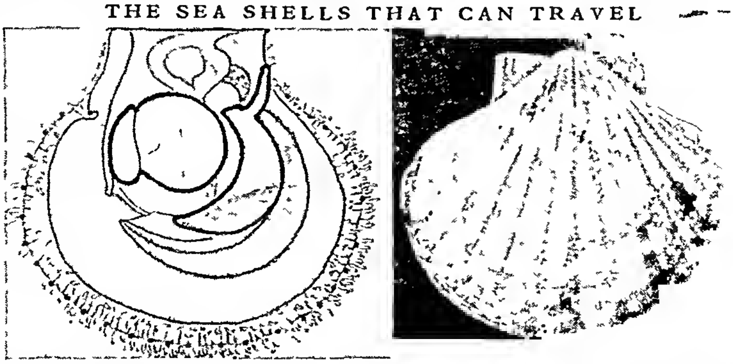
These scale insects as a usual thing are stationary except for a few hours after hatching. The males possess legs and a single pair of wings; but the females lose their six legs after molting, and thenceforth are grublike, wingless, and stationary, and are concealed under the mass of cast-off skins and a powdery, cottony, or waxy secretion. When the young are hatched they leave the shelter, and rove about the food plant for a time in search of a suitable place in which to insert their beaks and begin pumping up the sap. A few species are called "mealy bugs" more often than "scales," as they move about more freely.

Often the scales go unnoticed on the bark until they have attained great numbers, and this, together with the ease with which these insects and their eggs, when attached to living plants, can be transported long distances, has caused many species that infest cultivated plants to become distributed in almost every country in the world. Most of the highly injurious species found in the United States have been introduced from other countries, either on young trees or on fruit. Scarcely any kind of tree is free from their attacks. Certain of the species are constant pests in hothouses and conservatories.

While most of the species are pests and must be constantly combated by spraying, fumigation, etc., there are a few scale insects that are cultivated for the useful products they yield. The cochineal insect, a native of Mexico and other parts of Central America, has long been used for making a red dye (*see* Cochineal), and in Europe and Asia there are a few species of the scale insect which have been used for a similar purpose for centuries past. The lac-insect of far Eastern countries exudes a resinous substance, which when dried, pounded, washed, and purified becomes "lump-lac" or "shellac." (*See* Lacquer and Shellac.)

SCALLOP. Most "bivalves" soon settle down for life, but the scallop is a pilgrim. It does not fasten itself to rocks or timbers or form beds on the bottom of the ocean as do oysters, but roams from place to place. Tiny eyes rim the edge of the mantle inside the shells. The scallop moves by clapping the two shells forcefully enough to push itself for-

THE SEA SHELLS THAT CAN TRAVEL



It was the shell of this little creature that the pilgrims of the Middle Ages used to wear in their hats. And it was indeed a proper symbol, for the scallop itself is a sea traveler. It swims about in a zigzag fashion by clapping the two shells together. On the left, the black lines show the muscle that closes the shells. This is the only part that we eat. The dots on the rim are steely blue eyes.

ward in funny little zigzag leaps. The extensive journeying of the scallop made the shell a fitting emblem for travelers. In the Middle Ages pilgrims sometimes wore it on their hats to indicate that they had taken long voyages by sea. It was especially the emblem of pilgrims to the shrine of St. James at Compostela (Spain).

The scallops sold in fish markets are the large muscles which these mollusks use to open and close their shells. This is the only part of the scallop Americans eat. The remainder is discarded or used as bait. In Europe, however, the entire scallop is eaten.

Scallops belong to the family *Pectinidae* of the class *Pelecypoda*. This last name means "hatchet-footed." They are mollusks, related to oysters and clams (*see* Mollusks). Scallops are of two kinds—bay scallops and sea scallops. The bay scallop of the Atlantic coast (*Pecten irradians*) is taken from inshore waters. It is about three inches across and has a deeply grooved, arched shell.

The larger Atlantic sea scallop (*Pecten magellanicus*) occurs on offshore banks. It is about six inches across and has a rather flat shell without ridges. These two species account for the major portion of the United States production. Relatively small quantities of western bay scallops (*Pecten aequisulcatus*) are taken on the Pacific coast.

SCANDINA'VIA. Sweden, Norway, and Denmark together are called Scandinavia. The name is from an old term (Skaney) for a district in Sweden. Norway and Sweden share the Scandinavian peninsula, the northernmost peninsula of Europe. Denmark occupies a peninsula of its own, reaching north from Germany.

The people of the Scandinavian countries are closely related in blood, language, and history. They are typically a long-headed, blond people. They are of the Teutonic stock, like the Germans. Their ancestors were bold sea rovers known as the Northmen, or Vikings (*see* Northmen). The Northmen touched on the coast of North America centuries before Columbus and pushed into every corner of Europe. They left settlements in Russia, England, Ireland, and Scotland, in the Faeroes, the Orkneys, and the Shetland Islands, and in northern France, where they were called Normans. In all these places they merged with the original inhabitants. They also settled Iceland, which was united with Denmark until 1944; and Greenland, which still belongs to Denmark. In the 19th century Scandinavians emigrated to the United States in large numbers. Most of them settled in the northwest states, particularly in Wisconsin, Minnesota, and North Dakota.

Sweden, Norway, and Denmark were independent kingdoms until 1397. Then Denmark united them in the Union of Kalmar. Sweden withdrew from the Union in 1523. Norway remained practically a dependency of Denmark until 1814, when it passed to Sweden. In 1905 Sweden granted Norway its independence. (*See* articles on the separate countries.)

The close kinship of the Scandinavian peoples is shown in their languages. By about A.D. 1000 enough differences had crept into the parent Scandinavian tongue to make three dialects. These became the modern Swedish, Norwegian, and Danish languages. As the languages are spoken today they are still much alike, and Swedes, Norwegians, and Danes can understand one another fairly well.

The Scandinavians remained for a long time a people of action rather than a literary and artistic people. The sea was all about them, inviting them to seek fortune and adventure, while the stern and rugged land could not be conquered without a struggle. Scandinavian literature therefore begins rather late. Only within recent times have Scandinavian writers won standing as world figures.

Tales of Old Heroic Days

The oldest important works we know are two collections of Icelandic literature called the *Eddas*. The time when the Elder, or Poetic, Edda was written is unknown, but our knowledge of the work dates from about 1643. The Younger, or Prose, Edda was written by the great Icelandic poet Snorri Sturluson (1178–1241). Each Edda relates myths and heroic legends of the early Scandinavians. From them we get our stories of Odin and Thor and the other gods of northern mythology. Icelandic *sagas* also have come down to us. These are tales of old Viking days. They were first told by sagamen, or storytellers, who wandered from place to place. They are in prose with bits of poetry interspersed.

The modern period in Scandinavian literature had its real beginning in the 18th century. The Danish-Norwegian dramatist, Ludwig Holberg (1684–1754), who has been called "the Molière of the north," and the Swedish romantic poet Esaias Tegner (1782–1846) were prominent figures in their own lands; but Hans Christian Andersen of Denmark (1805–75), the wonderful teller of fairy tales, was the first to be adopted by the whole world (*see* Andersen).

A Series of Great Writers

Andersen showed what the world of fairyland was like. Other great Scandinavian writers, in the latter part of the 19th century, portrayed the world of reality and delved into the problems of life. To this period belong two great Norwegian writers, Björnstjerne Björnson and Henrik Ibsen. Björnson was a novelist as well as a dramatist. Ibsen, the greatest of Scandinavian dramatists, was in his own day probably the most influential writer in the whole world (*see* Björnson; Ibsen). Johan Strindberg, the Swedish novelist and dramatist, possessed powers in some respects as great as theirs. But his work was marred by his bitter and unhealthy pessimism.

In the 20th century all three countries produced distinguished novelists. Selma Lagerlöf of Sweden turned to the world of imagination and romance (*see* Lagerlöf). Martin Andersen Nexö pictured the peasant life of Denmark; Johannes Jensen, also of Denmark, traced the evolution of man in 'The Long Journey'. Johan Bojer and Knut Hamsun wrote somber stories of Norwegian life. Sigrid Undset traced Norway's history from Viking days down to modern times.

THE MAGIC APPLES OF IDUNA

In this painting, the goddess Iduna gives an aging Norse hero a magic apple to make him young again. She takes it from her wonderful casket that was always full when she opened it.

Two Scandinavian-American writers won fame by writing about their people. Hjalmar Hjorth Boyesen wrote of his native Norway in 'Gunnar' (1874). Ole Rolvaag, another Norwegian, wrote 'Giants in the Earth' (1927), an epic novel of Scandinavian pioneer life on the Dakota prairies during the 19th century.

An Ancient Scandinavian Myth

"The Apples of Iduna"—a myth about the coming of spring—was a favorite with the Northmen. They believed that the long, cold winter was caused by a triumph of the giants of Jotunheim over the gods. When spring returned the gods had prevailed.

In the shining city of Asgard where the gods dwelt lived Bragi, the god of poetry and eloquence, and his lovely wife Iduna (or Idun), goddess of youth. In the light of her warm smile no one could grow old, and the trees in her garden were always in bloom. Best of all, she had a magic casket filled with wonderful apples, which the Fates had allowed her to pluck from the Tree of Life. They had the power of giving youth to all who ate them.

One day Loki, the mischief-making god, fell into the power of the storm giant Thiassi. To gain his freedom he promised to help Thiassi steal Iduna and her apples. He persuaded Iduna to accompany him to a grove where he declared there were apples finer than hers.

When they left the walls of Asgard, a bitter wind blew and the sky was darkened by the wings of an enormous eagle. This was the giant Thiassi. Swooping down, he seized Iduna in his claws and bore her far away to the frozen land of the giants.

In Asgard the trees turned red and brown, the birds grew silent, and snow fell in the streets. The sun paled and dwindled and sank so low it nearly fell off the rim of the world. The gods grew old and gray.

At length the angry gods found that Loki had lured Iduna from Asgard. He promised to undo the harm he had wrought. Borrowing falcon plumage from Freya, the goddess of love, he flew to the bitter north and found Iduna imprisoned in a rocky cave by the frozen sea.

Changing her into a swallow, he set out with Iduna and her apples clutched in his falcon claws. The storm giant flew swiftly in pursuit. The gods, watching from the walls of Asgard, built a mighty fire. As Loki and Iduna cleared the walls, the fire flamed high, blinding the giant eagle. He fell within the walls and was killed. With Iduna back in Asgard, the earth burst the bonds of winter, trees budded, flowers bloomed, and the gods grew young and vigorous by eating the magic apples again. (*See also* Mythology.)

(For Reference-Outline and Bibliography on the Scandinavian countries, *see* Sweden.)

SCHELDT (*skĕlt*) **RIVER.** This historic little river rises in France, flows north through Belgium past Ghent and Antwerp, and enters the North Sea at Flushing. It is 250 miles long and is navigable for 207 miles. The Dutch, who possess both banks of the river at its mouth, long claimed the exclusive navigation of the lower Scheldt and demanded toll of foreign vessels. This right was confirmed by treaty in 1839, but in 1863 Belgium and other nations paid the Dutch more than 3 million dollars to remove the toll.

During the second World War, Antwerp and the Scheldt River were in German hands for four years. In September 1944, the Allies regained Antwerp, but the Germans clung to the estuary of the Scheldt, blocking use of the river until November. Then the Allies made the city a supply base (*see* Antwerp).

SCHENECTADY (*skĕ-nĕk'ta-dĭ*), N. Y. The popular slogan, "Schenectady lights and hauls the world," describes this city's chief industries—the manufacture of electrical equipment and of railroad locomotives.

Since 1886, when Thomas Edison opened a machine shop here, Schenectady has become known as America's "first electrical city." Since 1892, it has been the home of the General Electric Company, with the company's headquarters, its largest factory, and its research laboratories here. The company also has factories and offices in many cities and is one of the largest manufacturers of electrical apparatus and electrical home appliances in the world.

The other Schenectady manufacturing giant is the American Locomotive Company. It has its principal plant and main office in the city. From 1901 to 1948 its Schenectady plant made steam locomotives for America's railroads. In 1948, however, it changed to the manufacture of diesel electric locomotives.

The name Schenectady comes from the Indian word meaning "at the end of the pine plains." In Indian times the site was the terminus of a portage between the Mohawk and the Hudson rivers. In 1662 it was settled by the Dutch and became a fur-trading outpost. In 1690 the village was nearly wiped out by a French and Indian raid. Later, during the western migration, the town was a shipping center until completion of the Erie Canal in 1825. In 1831 the state's first railroad was built between here and Albany.

The city was chartered in 1798. In 1935 it adopted a city-manager government. Its public-school system carries on an extensive program of adult education. The city is the site of Union College, founded in 1795 and now part of Union University. Population (1950 census), 91,785.

SCHILLER, JOHANN CHRISTOPH FRIEDRICH VON (1759–1805). After Goethe, the greatest of German writers was Schiller. His classic plays 'Wallenstein', 'Maria Stuart', and 'Jungfrau von Orleans' (Maid of Orleans) are still widely read in German and in translation. Like Shakespeare's plays, Schiller's dramas are psychological studies of men and women in crises. They tell moving and tragic stories of the downfall of famous people in history.

Schiller was born Nov. 10, 1759, at Marbach in the duchy of Württemberg. His father was an army surgeon in the service of the Duke of Württemberg. In 1766 the family moved to Ludwigsburg where the duke resided. The boy was a good student. He wrote little plays which he and his sisters acted out. Later he composed verses in Latin and German. When he was 13 he entered the duke's military academy, called the Karlschule. The school authorities imposed strict military discipline, but Schiller found ways to write secretly. He started to study law and later turned to medicine. When he was 21 he was appointed surgeon to one of the duke's regiments.

His first play was 'The Robbers'. He wrote it while still a student and had it printed at his own expense. The play tells of a young man who becomes an outlaw because he has been wronged. He feels that his defiance will lead to greater liberty and democracy. But in the end he realizes that new wrongs will not right old ones and that freedom cannot be achieved by lawlessness and violence.

'The Robbers' became immensely popular in book form and on the stage. When the duke learned that Schiller had been leaving his regiment to see the play performed at Stuttgart, he put the young surgeon under arrest and forbade him to write anything more. But Schiller escaped and fled Württemberg.

For seven years Schiller struggled to earn his living as a writer. Then a friend introduced him to the Duke of Weimar, who was Goethe's patron (*see* Goethe). The duke made Schiller one of his councilors, and later he became professor of history at Jena University. In 1790 he married Charlotte von Lengefeld. They had four children.

Schiller became a close friend of Goethe, and in 1794 they started a journal called 'Die Horen' (The Hours). In 1799 Schiller moved to Weimar, partly to be near Goethe. This was the most productive period of Schiller's life. But his health gradually failed and he died in Weimar on May 9, 1805.

Schiller's chief plays are 'The Robbers' (1781); 'Don Carlos' (1787); 'Wallenstein' (1799); 'Maria Stuart' (1800); 'Maid of Orleans' (1801); 'Bride of Messina' (1803); and 'Wilhelm Tell' (1804). His 'History of the Revolt of the Netherlands' (1788) won him considerable fame as a scholar. He was also the author of many ballads and lyrics. Schiller's collected works, in German, number 15 volumes.

SCHLIEMANN (*shlē'män*), **HEINRICH** (1822–1890). As a child Heinrich Schliemann heard the heroic stories of the Trojan Wars and how the city of Troy had been entirely destroyed by fire. His clergyman father assured him that no trace of the city remained. But the boy reasoned that "lost" cities must leave some record. Not until he was 42 years old did Schliemann turn again to this problem. Then he led digging parties in the discovery of priceless treasures of the ancient world. Schliemann's work led to a far greater knowledge of early Greek civilizations.

Schliemann was born in Neubuckow in Mecklenburg, Germany, on Jan. 6, 1822. He had little formal education, and when he was 14 he was apprenticed to a grocer in Fürstenberg. In 1841 he hurt himself while lifting a cask and was discharged. He tried to get work in Hamburg and finally signed on as cabin boy aboard a brig. The ship was wrecked off the Netherlands coast. Safely ashore, Schliemann got a job as errand boy in an Amsterdam warehouse.

The job gave him time for study. Schliemann had a flair for languages, and in rapid succession he learned English, French, Dutch, Spanish, Italian, and Portuguese. Later he learned Russian and Greek. In 1844 he became bookkeeper for another company. Two years later the company sent him to St. Petersburg, Russia, as its agent. There he founded his own business importing indigo and tea. His business boomed during the Crimean War, and he became a rich man.

During the 1850's and 1860's Schliemann spent enough time in the United States to become an American citizen. He retired from business in 1863 and began to travel and study. His old interest in archeology reawakened and he visited the sites of early Greek cities. In 1870 he began excavations in the desolate region about Hissarlik in Asia Minor, where he believed the remains of ancient Troy were buried. His workers dug past the ruins of the Troy of Homer's time and found even older cities (*see* Trojan War). Later archeologists established that actually there had been nine cities on this site. After several years of this work, he crossed over to the Greek mainland and excavated the prehistoric cities of Mycenae and Tiryns (*see* Aegean Civilization).

Between excavations Schliemann lived in his Athens mansion filled with early Greek art objects. He married an Athenian woman, Sophia Kastroménos, in 1869. They had two children, Andromache and Agamemnon. Schliemann died Dec. 26, 1890, in Naples, Italy.

SCHOOL. Every civilized nation realizes that among the most important institutions in the world today are schools. Once governments allowed parents to decide whether or not children should go to school, but that time has passed in all progressive nations. Now compulsory education laws require that all children shall receive a certain minimum of education.

Although American colleges and universities have a long European ancestry, the public elementary school, with compulsory education, had its real beginning in the United States. It is now the prevailing policy of most countries that educational opportunities should be free and universal.

No National School System in United States

In the Constitution of the United States there is no provision concerning education. Hence the nation

has no nationally controlled system of schools. The Office of Education in the Federal Security Agency is primarily an establishment for educational research and promotion. In Alaska, where the natives are regarded as government wards, the native schools are administered by the Bureau of Indian Affairs in the Department of the Interior. This office also has charge of the Indian schools in the United States. Education in each island possession of the United States is directed by the American governmental department in charge of the island. The Department of the Army administers the military academy at West Point, and the Navy Department administers the naval school at Annapolis.

Many parochial, or church, schools have been established since about 1840. Most of these are under the direction of the Roman Catholic church, although some are maintained by other denominations, particularly the Lutherans. They give both elementary and secondary preparation.

Public educational institutions are managed and financed in the main by the states and cities. Full freedom to exist and carry on their work is granted to private and parochial schools. The Federal government itself has played an important part in education by giving endowments of land and money to help establish educational institutions. The land thus far given for common schools alone totals nearly 100 million acres. It also provides money that enables school cafeterias to offer below-cost lunches.

Great Changes in School Systems

The present school system of the United States has become exceedingly complex because of increased enrollments and a desire to meet the varied needs and interests of pupils of all classes and talents. In the older system every boy and girl was given the same kind of training. Today, after elementary school, the student can choose the type of education which best suits his needs and ability.

Years ago the American educational system included only three units—grade school, high school, and college. Now there are at least seven distinct types. The preschool level has the nursery school and the kindergarten; the elementary education level has the grade school of six grades; and the secondary education level, the junior high school of three years and the senior high school of three years. The higher education level has the junior college of two years, the college or university, and the graduate school, generally rather specialized.

Classes for Workers, Old and Young

Part-time, or continuation, schools offer courses, frequently in the late afternoon and evening, both for employed boys and girls and for adults. In many states attendance is compulsory, usually until the age of 16. These schools meet individual needs through vocational as well as basic courses in the elementary and secondary curriculums and encourage initiative and the development of abilities.

Social and industrial changes led to the adoption of the platoon, or work-study-play, system by many of the cities of the United States, where it originated in 1907, and in some cities of Canada. Classrooms, gymnasiums, workshops, and laboratories are in use the whole day, since the platoon school has two fully organized sections that carry on the regular work of the first eight or nine grades.

In parental schools, children who present unusual problems in discipline and learning receive special help in their tasks of adjustment. Teachers meet the needs of these pupils sympathetically through play and work. They help overcome difficulties in temperament and develop study interests.

In addition to these schools there are normal schools and teachers colleges for training teachers; reform schools for wayward boys and girls; schools for physically handicapped pupils and for the feebleminded; summer schools; commercial and vocational schools; correspondence schools; university extension courses; and many others. (*See also* Education, Kindergartens and Nursery Schools; Universities and Colleges; Vocational Guidance.)

SCHUBERT (*shö'bĕrt*), **FRANZ PETER** (1797–1828) As a composer of songs Franz Schubert is without a rival. He turned poems into music almost as easily as he breathed. He wrote eight songs in one day, 146 in a single year. His compositions brought the art of song writing in Germany to its peak.

Schubert wrote other fine music as well as songs His "Unfinished" and C-Major symphonies are popular today. His A-Flat and E-Flat masses are among the truly great masses. Many of his string quartets and other chamber works are favorites. Melody fills his instrumental music as it does his songs.

Schubert was born in Lichtenthal, a village just north of Vienna, on Jan. 31, 1797. His father was head of the parish school. The family was poor but musical. Franz's father and brothers taught him to play the piano, violin, and viola, and he played the viola in the family string quartet. At seven he became a soprano in the village choir. Four years later his exquisite singing won him a place in the Vienna court choir and preparatory school. He became first violinist in the school orchestra and often acted as assistant conductor. He began to compose regularly when he was about 13. A friend gave him music paper, because he could not afford to buy it. When Franz was 16 and his voice changed, he had to leave the imperial school. He taught for three years in his father's school, then gave up this uncongenial work and lived only for music.

As he reached manhood Schubert was still very short, about five feet tall. He was fat and had curly hair and a dimpled chin. His near-sighted eyes needed thick glasses which he wore even to bed. He loved companionship and good times. But he was able to concentrate, and often at some tavern, surrounded by noisy friends, he would write a song.

Schubert was always poor. His songs and piano pieces became popular but brought him little money. He applied twice without success for a position as orchestral conductor. He wrote several operas in an

effort to earn money, but these failed. Though he was poor he had many friends, and they helped him financially from time to time. In 1828 they arranged a benefit concert of his works. Schubert died Nov. 19, 1828, of typhus when he was only 31.

Schubert wrote over 600 songs. Among the best known are 'Erlkönig' (The Erl King), 'Der Wanderer' (The Wanderer), 'Der Doppelgänger' (The Double), 'Gretchen am Spinnrade' (Gretchen at the Spinning Wheel), 'Sylvia', and the song cycles 'Die Schöne Müllerin' (The Miller's Beautiful Daughter) and 'Die Winterreise' (The Winter Journey). He completed 7 symphonies and wrote 7 masses, 3 operas, 16 string quartets, and many other instrumental and choral works.

SCHUMANN, ROBERT (1810–1856). The romantic movement in music had one of its great leaders in Robert Schumann. He was important both as a composer and as a critic.

TWO GREAT COMPOSERS

The upper picture shows Franz Schubert, Austrian master of song and melody. The lower picture shows Robert Schumann, German romantic composer and a critic who encouraged the finest in music.

Schumann was born June 8, 1810, in Zwickau, Germany. His father was a prosperous bookseller and editor. From him Robert inherited a love of romantic poetry. When he was 14 he published some verses. His father encouraged his artistic development, but died when Robert was 16. Two years later the boy began to study law at Leipzig, largely to please his mother. His real interest lay in music. In 1830 his music teacher, Friedrich Wieck, persuaded Robert's mother to let him give up law.

At that time Schumann wanted to become a great pianist. While practising according to a curious method he had invented, he crippled one of his fingers and had to give up this ambition. The world profited by his misfortune, for the accident turned Schumann to composing great music.

The romantic feeling in Schumann's work reflects in part his love for Clara Wieck, daughter of his teacher. They were married in 1840 and had eight children. She was a charming girl as well as a famous pianist. In the years when he was trying to win her hostile father's consent to their marriage and in the year after she became his wife, Schumann composed some of his finest music, including many delightful compositions for the piano, two symphonies and a symphonic work with overture, and about 150 songs. Shortly afterward he wrote his great cantata 'Paradise and the Peri' and began his music to Goethe's dramatic poem 'Faust'.

Schumann's life should have been very happy, but for a shadow cast over it by an inherited tendency to melancholia. His wife's tender care and sympathy helped him, but finally in a fit of insanity he attempted to drown himself in the Rhine. He was rescued but died July 29, 1856, at the age of 46 in an asylum at Endenich, near Bonn.

Schumann had a very great influence on the musical art of his time. For a number of years he edited a musical journal and through his criticism encouraged the best in music. He was among the first to recognize the great genius of Brahms, Chopin, and Berlioz.

Not counting a youthful work composed when he was 20, Schumann wrote four symphonies. They are the Symphony No. 1 in B-Flat Major (the 'Spring Symphony', composed 1841); No. 2 in C Major (1845–46); No. 3 in E Flat Major (the 'Rhenish Symphony', 1850); and No. 4 in D Minor (1841, revised in 1851).

SCHWEITZER (*shvī'tsẽr*), **ALBERT** (born 1875). By the time he was 30 years old, Albert Schweitzer was a brilliant minister and musician. He was head of a theological college and pastor of a large church in Alsace. Music-lovers acclaimed Schweitzer as the greatest living interpreter of Bach's organ music. But Schweitzer's deeply religious nature made him turn away from worldly honors and choose a life of self-sacrifice. At 30 he entered medical school, specializing in tropical medicine. Then as a medical missionary, he set up a tiny hospital for the natives at Lambaréné in French Equatorial Africa.

Although hidden deep in the jungle, Albert Schweitzer was not forgotten. Late at night after his long day's duties were done, he wrote books on theology and philosophy. In these he expounded his theory of "reverence for life" as the keystone for understanding the universe and the human mind and spirit. Schweitzer's "reverence for life" included not only

human life, but all living things, plant and animal. In his jungle hospital he liberated insects trapped by window screens, and he regretted having to kill bacilli in his medical treatments. In his second career Schweitzer won the world's acclaim anew for being one of the few exalted spirits of his time.

Schweitzer was born Jan. 14, 1875, in Kaisersburg, Upper Alsace. Soon after, his father became pastor of the Evangelical church at Günsbach. Even as a child Albert was sensitive to suffering. He insisted that he be no better fed or dressed than the poorest of his schoolmates. After attending the village school he entered the gymnasium at Mülhausen. He had begun music lessons at home, and here he continued his studies on the organ. After graduation he studied for a time in Paris under a noted French organist. But Schweitzer decided against music as a career, and in 1893 he entered the University of Strasbourg.

ALBERT SCHWEITZER

Schweitzer won deep respect for his life of devotion and sacrifice.

He won his Ph.D. degree in philosophy in 1899 and continued his studies in theology. He was appointed pastor of St. Nicholas Church in Strasbourg and later became head of the Theological College of St. Thomas Schweitzer made his momentous decision to study medicine in 1905 Six years later he won his medical degree. In 1912 he married Helene Bresslau, who studied nursing to help her husband. The next spring they sailed for Africa.

During the first World War, Schweitzer and his wife were interned in France. Illness kept him from returning to Africa until 1924. Meantime he raised money for the hospital by lectures and recitals. He visited America in 1949 to speak at the Goethe bicentennial. The 1952 Nobel peace prize was awarded him in October 1953.

How Men DEVELOPED *the* POWERS *of* SCIENCE

SCIENCE. Modern times are often called the Age of Science. Television, radio, and electric power are examples of what scientists have created. Science has developed modern medicine and surgery, aviation, and chemistry. Scientists are even helping men learn to live together peaceably by studying their ways.

Most civilized people know something about how scientists work. Physicists and chemists have laboratories where they perform tests and experiments. Biologists use microscopes and chemical apparatus to study plants and animals. Students of human affairs work in offices where they use statistics and other records of what human beings are and do.

How Scientists Work

All this suggests that scientists gain new knowledge by observing, measuring, testing, and experimenting. They do, but they conduct their search for knowledge in certain definite ways. Together, these ways are known as the *scientific method.* This method came into being only a few hundred years ago. It differs from earlier thinking by insistence upon careful measurements and use of careful experiments. This kind of evidence minimizes mistakes caused by errors in selecting facts or in judging their value.

Working methods must be suited to the subject being studied. Astronomers use measurements upon photographs obtained through telescopes and other instruments. They cannot experiment with the heavenly bodies. Physicists and chemists can experiment freely with substances and forces in their laboratories. Biologists can experiment with plants and animals by altering their food or other factors affecting their lives and observing the results.

When scientists attack a problem, they first set down what is known and try to determine new facts. Many scientists form a working theory (called a *hypothesis*) about what is causing the observed results. Then they measure, test, or experiment to learn whether the hypothesis works out as expected. If it does, the hypothesis becomes a tested theory. Some scientists prefer to wait until their work is almost finished before they form a theory about the results. In either case a theory is never considered proved until it seems plain that *no other theory* explains the known facts so well.

Finally, scientists never consider anything as proved beyond possibility of question. They accept a theory or law as true as long as it explains all the known facts. But scientists know that some new fact may be discovered at any time which cannot be explained by the theory. Then they change theories to explain the newly learned fact. Nothing in science is final other than use of the scientific method and insistence upon scientific tests of truth.

Slow Progress toward the Scientific Method

Ever since men have been on the earth they have tried to gain knowledge by observing and trying out new ways of doing things. But they could not explain the seasons, the reasons for life and death, and other great natural phenomena by such simple means.

Primitive people explained such puzzling matters by inventing myths (*see* Mythology). According to their beliefs, nature was controlled by spirits. Men tried to control nature by winning the favor of these spirits with charms, ceremonies, and sacrifices (*see* Magic). Such beliefs hampered the growth of real knowledge. Men feared to think freely lest they offend the spirits and bring misfortune.

The first people who dared to think seriously about natural forces simply as forces and not as the acts of

spirits were the ancient Greeks. From around 600 B.C. to about the birth of Christ, Greek philosophers organized the foundations of almost every modern science. The very names bespeak this origin. Most of them end in "-nomy" or "-metry" or "-logy." These endings reflect the Greek words *nomos*, "law"; *metron*, "measure"; and *logos*, in this connection, "knowledge." The first parts of the names are from such terms as *anthropos*, "man"; *astron*, "star"; *bios*, "life"; and *geo-*, "earth." Many of the names were coined by the philosopher Aristotle (*see* Aristotle).

The Greek philosophers were not completely scientific. They tried to discover truth by observation and reasoning alone. They did not experiment because that involved handwork, something which was fit only for slaves. They often accepted theories that explained *most* of the facts, not *all*. Many errors thus remained beliefs until modern science was born.

Birth of Modern Science

In time the Romans conquered the Greeks and the search for new knowledge languished. Ancient Greek learning was cherished by the Arabs and the Greek-speaking people of the eastern Mediterranean, but they added little to it. Late in the Middle Ages the search for knowledge was renewed. A pioneer was the friar Roger Bacon, who grasped the point the Greeks had missed. He used experiments to test his theories and to develop new devices (*see* Bacon, Roger).

This new spirit was not fully realized until the 16th and 17th centuries. By then men were skeptical about the beliefs of the past. The Polish astronomer Nicolaus Copernicus questioned the old theory that the sun moved around the earth, and in 1543 he published his "Copernican theory" of planetary motion (*see* Copernicus). The same year Andreas Vesalius published a work on anatomy. Based upon the results of dissection, it provided a sound foundation for this science.

During the next 150 years, many other foundations of modern science were laid. In England, Francis Bacon's book 'Novum Organum' (The New Method) laid down principles of the scientific method used by modern investigators. Two British physicians also contributed great discoveries. William Gilbert investigated electricity and magnetism and was the first to understand the magnetic attraction of the earth. William Harvey discovered the circulation of the blood (*see* Blood). In Italy, Galileo Galilei discovered new facts about the heavenly bodies with the recently invented telescope (*see* Galileo).

Johann Kepler showed the truth of Copernicus' theory (*see* Kepler). In 1687 Sir Isaac Newton published his theory of universal gravitation, which explained the motions of matter in the universe (*see* Newton). In Newton's time the Irish scientist Robert Boyle pointed the way to modern chemistry and physics (*see* Gas). The later growth of scientific knowledge is told in articles on the different sciences.

Most modern governments support scientific research as a vital aid to national progress and security. In 1950 the United States created the National Science Foundation "to promote basic research and education in the sciences."

SCORPION. The scorpions are relatives of the spiders but look like little crawfish with thin tails. A scorpion's principal weapon is a sting. This is a curved, hollow needle carried at the end of the tail. Through a hole in its tip the scorpion can squeeze out poison from a sac in the last joint of the tail.

When a scorpion has grasped a victim in its claws, it is said to be most careful in feeling for a soft spot to sting. A random thrust might break the sting against, say, a beetle's tough armor. The poison kills small creatures and can cause human beings much pain. Poison from a large tropical species can kill a person who is weakened when he is stung. A scorpion keeps the sting out of harm's way by carrying its tail curved over its back.

Scorpions are found only in warm countries. They range from one to eight inches in length. Some small species are rather common in the southern portions of the United States. During the day most scorpions lie hidden under stones and logs or in holes and are rather slow and torpid. At night they come out and are very quick and active. They eat small insects, spiders, lizards, toads, slugs, snails, and even small mammals such as mice and shrews. They are not vicious unless disturbed and seldom do harm to man. The mother scorpion brings forth her young alive and carries them about on her back for some days. Young scorpions resemble their parents. They shed their skins as they grow. Scorpions, spiders, and certain other eight-legged creatures belong to the class *Arachnida*.

COURTSHIP AMONG THE SCORPIONS

Scorpions are seen together only when they fight or are courting. In courting they clasp claws and dance. The dance may last for hours. After mating, the female kills and eats the male.

The SCOTS *and Their* COUNTRY

The Scottish Highlands have a picturesque beauty, but Highland farmers can make only a bare living from the stony soil. This small village is Kinlochbervie, on the northwest coast. Here the people combine farming with sea fishing.

Extent.—North to south, about 275 miles; east to west, 150 to 40 miles. Area, 30,405 square miles, including 186 islands (chiefly Shetlands, Orkneys, Hebrides, Arran, and Bute). Population (1951 census, preliminary), 5,095,969.

Natural Features.—Highlands in northern half, central Lowlands, and southern Uplands. Ben Nevis, 4,406 feet, highest point in British Isles. Rivers: Clyde, Tweed, Forth, Tay, Dee, Don, Spey. Loch Lomond, largest of many lakes. Climate cool and rainy.

Products.—Oats, barley, potatoes; sheep, cattle, dairy products; herring, haddock, cod, and other fish; coal; iron and steel manufactures, ships, textiles, whisky.

Cities.—Glasgow (1,089,555); Edinburgh (466,770); Aberdeen (182,714); Dundee (177,333).

SCOTLAND. The northern part of the island of Great Britain is Scotland. Rugged uplands separate it from England to the south. In this border country the Scots fought many wars to keep their independence. Finally in 1707 Scotland voluntarily joined with England and the entire island became a single kingdom, Great Britain. The Scots, however, remain a distinct people; and they have a long history different from that of England.

Scotland is a land of romance. It contains ruins of many ancient castles and abbeys; and there is a haunting beauty in its windswept mountains, long deep valleys, and ribbon lakes. It attracts many tourists, particularly from America and England. But it is a poor country, difficult to make a living in. Perhaps that is why it has bred such a vigorous people and why so many Scots have left their homeland to settle in other lands. There are many more people of Scottish origin scattered over the world than there are in Scotland.

A Ragged Coast Line

Scotland lies between the Atlantic Ocean on the west and the North Sea on the east. The coast is deeply pierced by inlets from the sea. The larger inlets are called *firths*. Long, narrow inlets are called *sea lochs*. On the rugged west coast the sea lochs are framed by great cliffs and resemble the fjords of Norway.

Numerous islands line the coast. In the north are two large groups, the Orkney Islands and the Shetland Islands. Close to the west coast are the Hebrides group, Arran, and Bute. Including these islands, Scotland's total area is smaller than the state of

Maine. (*See also* Orkney Islands; Shetland Islands; Hebrides Islands.)

Highlands and Lowlands

The land consists of three distinct regions: (1) the Highlands, in the north, (2) the central Lowlands, and (3) the southern Uplands.

The Highlands are wild and picturesque. The mountaintops are rounded. The upper slopes are rocky and bare. The lower slopes are brilliant with purple heather in late summer. The valleys are usually narrow and steep-sided *glens*. At the bottom of the glen there is usually a lake (*loch*), also long and narrow. A straight line of lochs crosses the Highlands from southwest to northeast. This long, narrow valley, called Glenmore, divides the Highlands into two sections. In the southern section are the Grampian Mountains, highest in the British Isles. Ben Nevis, the tallest peak, rises to 4,406 feet. More famous is Ben Lomond, which rises from the shore of lovely Loch Lomond, the largest lake in Scotland.

The central Lowland belt is only about 30 miles wide. From southwest to northeast the greatest length is nearly 90 miles; but it is only 30 miles across the narrow "waist" of Scotland—from the head of the Firth of Clyde in the west to the Firth of Forth in the east. These firths provide valuable outlets to the sea, but they restrict communications from north to south into this narrow neck. The soil is both deep and fertile and four coal fields underlie the area. Here consequently is Scotland's chief farming district and here also are its largest cities. In the east is Edinburgh, Scotland's historic capital. In the west is Glasgow, center of a great industrial area. Almost 90 per cent of Scotland's population lives in the Lowlands.

In the southern Uplands the hills are less than 2,000 feet high. Their rounded or flat tops are often capped with dark peat. The slopes are covered with grasses as well as heather. In this border country England and Scotland meet. In the west the boundary runs from the Solway Firth across the crest of the Cheviot Hills. In the east it follows the River Tweed almost to its mouth. The Tweed Valley is the chief gateway into England. The English people often refer to Scotland as "north of the Tweed."

The Climate Is Cool, Rainy, and Windy

The wind is usually from the southwest. It blows over the North Atlantic Drift, a continuation of the warm Gulf Stream, and this makes the climate warmer than it would otherwise be so far north (*see* Gulf Stream). The average temperature in January is about 40°F.; in July it is about 58°.

The mountainous west coast has the most rain. Ben Nevis, which is close to the coast, has an average yearly rainfall of more than 150 inches. The east is drier and sunnier. The wettest seasons are autumn and winter. June is the finest month; and June days are very long.

The Scottish People

The Highlanders are of Celtic stock, and some of them still speak Gaelic, an ancient Celtic language (*see* Celts). The Lowlanders are much like the people of northern England. They speak English—but their Scottish dialect is sometimes hard for the English to understand. The Scots have a reputation for being exceedingly thrifty, cautious, and careful of detail. But they are far from being all alike. Scotland is a country in which individualism flourishes.

Most of the churchgoing people belong to the national church of Scotland, which is Presbyterian. The congregation of each "kirk" chooses its own minister, after a trial, and every member of the church has some share in governing it. In general, sermon and prayer occupy a larger place in the church service than ritual and music. The Roman Catholic church has many members in the Glasgow area, which has a large Irish population. The Episcopal church of Scotland resembles the Church of England but is an independent body. Other denominations include the Baptists, Methodists, and Congregational Union.

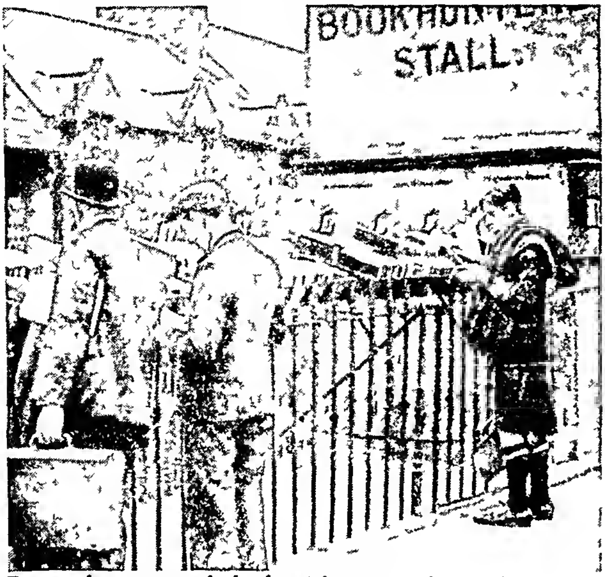
The Scots have a great respect for learning, and their history is full of the names of men of humble birth who nevertheless acquired a university education. The way was made easier for poor students by Andrew Carnegie, Scottish-born American industrialist. He set up the Carnegie Trust fund, in 1901, to help needy students with their fees and to foster research.

Education is free from nursery school (three to five years) through secondary school. At about 12 years of age, the student is tested to determine whether he should go to a junior secondary school (12 to 15 years) or to a senior secondary school (12 to 18 years). The senior schools lead to the professional schools and universities. Scotland has four universities: St. Andrews, Glasgow, Aberdeen, and Edinburgh.

THE REGIONS OF SCOTLAND

The Highlands, in the north, are beautiful but barren. Most of the people live in the central Lowlands, the busy industrial area. The southern Uplands is the "border" country where Scotland and England meet.

A BOOKSHOP IN EDINBURGH



Passers-by can sample books at leisure in this outdoor bookstall. The boy wearing modified kilt dress is a student.

Edinburgh is famous for its school of medicine. Glasgow emphasizes science and engineering.

Life in the Scottish Highlands

Most of the Highlanders are small farmers, called *crofters*. Their farms are usually at the head of a glen where a river has deposited soil from the mountains. The houses are built of stone gathered from the hillside. They are roofed with corrugated iron or a thatch of reeds and heather. Peat cut from the moors furnishes fuel for cooking and heating.

On his small farm the crofter can produce barely enough food for his family. Therefore he dislikes waste and has earned a reputation for being extremely frugal. He is a good farmer, but poor soil and excessive rain restrict his crops to oats, potatoes, and barley. He spends much of his time fishing—in lakes and streams if he is inland, or in the sea if his croft is near the coast. He also raises sheep on the hills and pastures a few shaggy horned cattle in the glen. Oats and fish are the chief foods. With oats the housewife makes porridge, served with milk and salt, and crisp oatcakes.

In August the tourist season begins. People from the Lowlands and from England flock to the Highlands to fish for salmon and trout or to hunt deer and grouse. The crofters then find work in hotels or serve as guides, boatmen, or gillies (attendants on hunters).

The Highlands today are sparsely populated. For centuries many of the young people have been leaving the crofts to find work in the industrial Lowlands or to emigrate to other countries. The government is trying to check this trend. Its reforestation program gives part-time work to crofters at the same time that it improves the land. The government is also harnessing the abundant water power of swift streams to furnish electric light and power for farms and factories. At present the only industries in the Highlands are woolen weaving and the distilling of "Scotch" whisky, which is made from barley.

The Gatherings of the Clans

In early days the rugged land caused the separation of the Scots into small groups, called *clans*. Each clan was ruled by a chief. All the people of a clan had the same surname, which often began with "Mac," as MacDonald, MacKinnon, MacLean, MacLeod. The clansmen wore a kilt (a short, pleated skirt), suitable for climbing the rough hills; and a plaid (blanket) for a cloak. Each clan had its own colorful pattern—called a *tartan*—for weaving cloth. (These patterns are now commonly called plaids.) Today the kilt is not a crofter's dress but a national costume, proudly worn for special occasions.

The "gatherings" of the clans draw many visitors, especially to Inverness, which is called the "capital of the Highlands." At these gatherings athletes wearing kilts compete in ancient Highland sports such as "throwing the hammer" and "tossing the caber." (A caber is a long, heavy pole.) Pipers and Highland dancers add color and interest to the gatherings.

A favorite winter sport is the "roaring game" of curling, played on the ice (*see* Curling). The game of golf developed in the east, where the great stretch of seaside turf made a natural course with sand traps as natural hazards.

Cities and Farms of the Lowlands

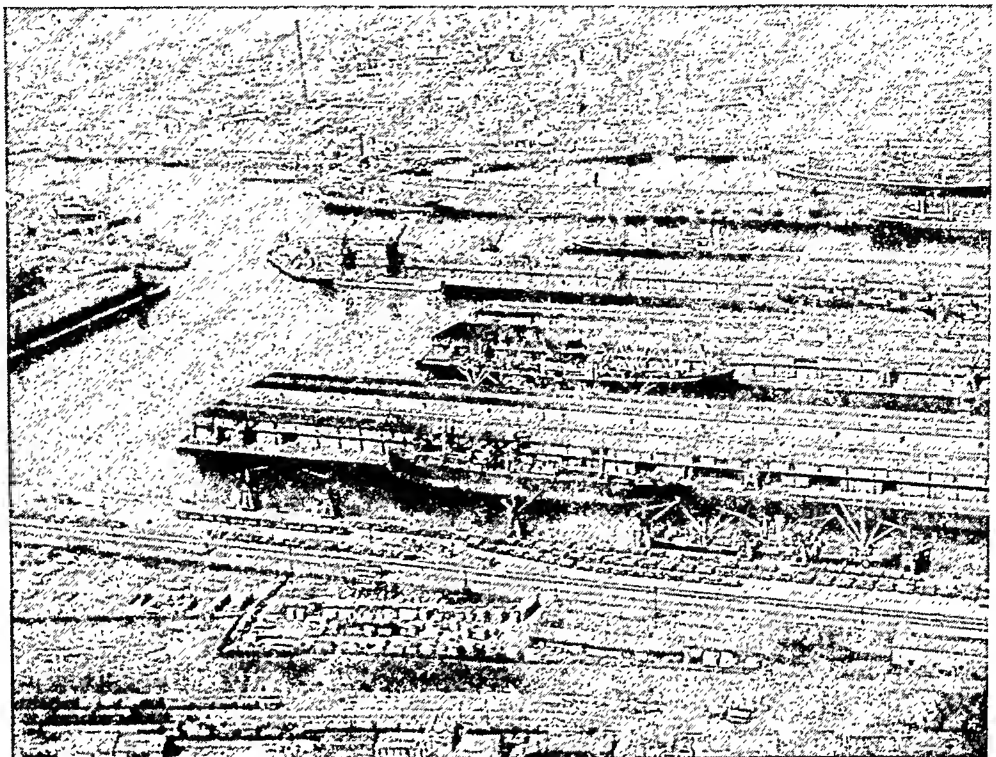
Scotland's great industrial area centers in Glasgow, its largest city (*see* Glasgow). On the banks of the

DRESSED UP FOR A GATHERING OF THE CLANS

The man playing the bagpipes belongs to a Highland band. The couple is dancing the spirited Highland fling. For both men and women the Highland dress includes a kilt (skirt), a plaid (cloak), and a sporran (ornamental purse).

River Clyde, below the city, are world famous shipyards that produce every kind of ship, from ocean liners and battleships to small tugs and pleasure yachts. In Glasgow itself and in the cities clustered around it are engineering works, metal industries, chemical works, and textile factories. These industries were based on the iron and coal of the great Lanarkshire field, north and east of Glasgow. Scotland's iron is now practically exhausted, and it is feared that the coal of Lanarkshire will also soon be gone. There is still plenty of coal, however, in fields around the Firth of Forth. In these fields modern mechanical processes are being introduced.

THE BUSY DOCKS OF GLASGOW



Continual dredging has made the small River Clyde deep enough to allow ocean liners to reach Glasgow. In the 21-mile stretch below Glasgow the river is lined with shipbuilding yards, repair yards, quays, docks, dry docks, and warehouses.

The industrial area around Glasgow almost meets that of Edinburgh to the east. Edinburgh also has engineering industries; but it specializes in light manufactures—printing, paper (made from imported wood pulp), beer, and biscuits (*see* Edinburgh). North of Edinburgh, across the Forth, are Dunfermline, which manufactures linen; Perth, known for its dye works; and Dundee, which specializes in jute manufactures and marmalade. South of Edinburgh, in the Tweed Valley, are manufacturing towns that produce the woolen cloths known all over the world as tweeds. In the Middle Ages, the woolen industry centered in monasteries such as Melrose Abbey, whose ruins still give interest to the valley.

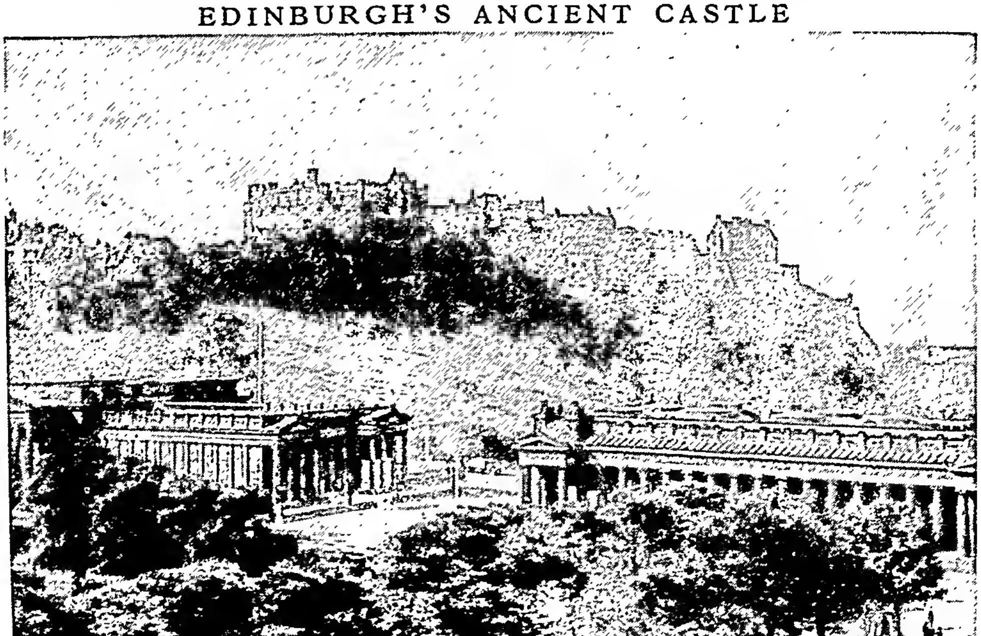
Scotland's great international airport, Prestwick, is on the west coast, southwest of Glasgow. The coast here is almost free of fog in both summer and winter.

Around the Forth lies Scotland's richest agricultural area. Here large well-managed farms produce wheat, oats, barley, potatoes, vegetables, and fruits. Scotland's seed potatoes are highly prized in England because they resist disease and yield heavy crops.

Sheep and Cattle in the Southern Uplands

Grass is the chief crop in the southern Uplands. The most important product is, therefore, livestock.

EDINBURGH'S ANCIENT CASTLE



High above the modern city of Edinburgh towers this rocky ridge, crowned by Edinburgh Castle. The castle was once the residence of Scottish kings. The classical buildings in the foreground are the National Gallery (left) and the Royal Academy (right).

In summer thousands of sheep roam over the hills. In winter they are "folded" into the valley farm. They are now raised more for mutton than for wool. In the valleys the farmers grow roots and other fodder crops.

In the southwest the climate is mild and rainy. Here are great dairy farms that furnish milk for the Glasgow area and for cities in northern England. At central points, such as Dumfries, are cooperative creameries. Waste products are returned to the farms to feed pigs.

Fishing Off Scotland's Coasts

Fishing towns are scattered all around the coast of Scotland and the islands. The chief fishing port is Aberdeen, on the east coast (*see* Aberdeen). Herring fishing begins off the west coast in early summer. The fleets follow the shoals of herring around the coast to the North Sea fishing grounds, reaching Aberdeen about September. Meanwhile on shore people travel from port to port to clean, cure, and salt the herring. Some are sold fresh, but most are pickled in brine or cured to make kippers or bloaters.

"White fishing"—for cod, haddock, plaice (flounder), and hake—is carried on by deep-sea steam trawlers all the year round. Lobsters, found in rocky pools, are plentiful on the northwest coast. They are caught in baited wicker traps.

How Scotland Is Governed

Scotland has no parliament of its own. It elects members to the British House of Commons in London, and it is represented also in the House of Lords. The central administration is in the hands of the secretary of state for Scotland, a British cabinet officer. He is head of the Scottish Office in Edinburgh, the "capital" of Scotland. This office has been gaining an increasing importance in Scotland's domestic affairs. Local government is in the hands of county and town councils.

The Scots still have their own law. It derives from the Roman code and is quite different from that of England. The supreme civil court, called the Court of Sessions, dates from 1532. It sits in Edinburgh in the old Parliament House.

The History of Scotland

The history of Scotland begins in the 1st century A.D., when the Romans invaded Britain. The Romans added southern Britain to their empire as the province Britannia. But they were unable to subdue the fierce tribes in the north. To keep these barbarians from invading Britannia, they built a massive wall across the island from sea to sea. They called the land north of the wall Caledonia; and they called the people Picts (from the Latin *pictus*, meaning "painted") because they painted their bodies. Parts of the Wall of Hadrian still stand on the Scottish border.

In the 5th century Celtic immigrants from Ireland, called Scots, settled north of the Clyde. The Scots were already Christians when they left Ireland. In the next century St. Columba converted the king of the Picts to Christianity. In the 9th century Kenneth MacAlpine, king of the Scots, joined the Pictish kingdom to his own. About the 10th century the land came to be known as Scotland.

After the Normans conquered England (1066) many Anglo-Saxons from England settled in the Scottish Lowlands. Here the Scots gradually took on English ways. Feudalism was established and the chiefs of the clans became nobles. Towns grew, trade increased, and Scotland prospered.

Scotland's War of Independence

In 1290 Margaret, heiress to the throne, died. Thirteen claimants contested the crown. Edward I of England claimed the right to bestow it and made John de Baliol king. But when Edward asked John for help against the French, John entered into an alliance with France. For 260 years Scotland held to this "auld alliance" with England's enemy.

Edward crossed the border in 1296, took John de Baliol prisoner, and proclaimed himself king of Scotland. To symbolize the union, he carried off the ancient Stone of Scone, on which Scottish kings had long been crowned, and placed it in the throne at Westminster Abbey.

Soon after Edward returned to England, the Scots rose again.

A HIGHLAND SHEPHERD TENDS HIS SHEEP

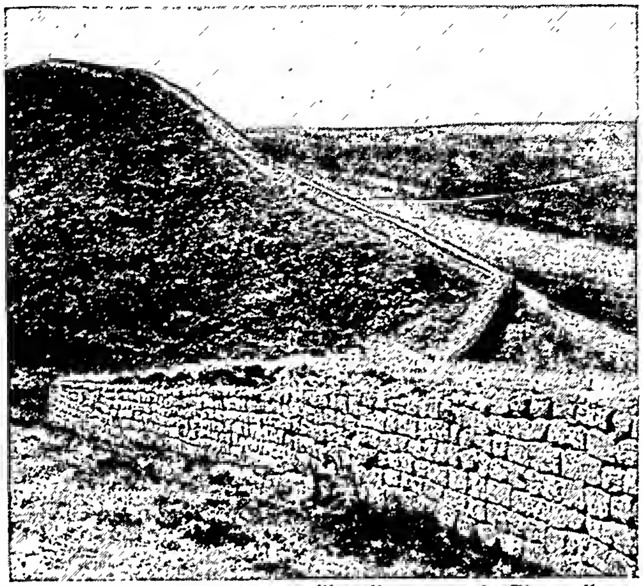
This is a typical Highland scene. The river widens into a long, narrow lake in the valley bottom. The moor is covered with heather and other rough grazings. Every few years the shepherd burns the heather to promote young growth for his hill sheep.

Led by William Wallace, they routed the English forces at Stirling (1297) and pursued them across the border. But the next year Edward returned and inflicted a disastrous defeat on the Scots at Falkirk. Wallace was later betrayed and captured, and the English hung his head from London Bridge (*see* Wallace).

The Scots' spirit was still unbroken, and they soon found another great champion in Robert Bruce (*see* Bruce). The last great battle of the War of Independence was fought in 1314 at Bannockburn, near Stirling Castle. There Bruce inflicted a disastrous defeat on superior English forces led by Edward II. In 1328 Edward III formally recognized Scotland's independence.

In the later Middle Ages Scotland suffered from weak kings and powerful nobles. For two centuries there was unending struggle between the crown and the barons. Clashes on the border also continued. James IV of Scotland married Margaret, daughter of Henry VII of England, in 1503. This marriage was to lead to the union of the crowns of both countries in 1603. But when Henry VIII went to war with France, James IV invaded England. He fell, "riddled with arrows," at Flodden Field, in the last great border battle (1513). James V died brokenhearted after his army had been slaughtered at Solway Moss (1542). The throne then went to his infant daughter, Mary Stuart.

THE ROMANS BUILT THIS WALL



Parts of Hadrian's Wall are still well preserved. The wall ran from sea to sea, along a line not far from what is to this day the border between England and Scotland. It was built by the Roman emperor Hadrian and finished about A.D. 127.

The Reformation and Its Consequences

Meanwhile the Protestant Reformation had swept across Europe and into England. Scotland was still a Catholic country. Its young queen, Mary Stuart, was in France when John Knox returned home to Scotland from Geneva. Knox was a follower of John Calvin, one of the leaders of the Reformation (*see* Knox; Calvin). With fiery eloquence he spread Calvin's Protestant doctrine. When Mary returned, Knox and others drove her out of Scotland. She fled to England. There Queen Elizabeth I made her a prisoner and finally had her executed (*see* Mary Stuart). In 1560 Scotland's parliament adopted a confession of faith drawn up by Knox and established the Church of Scotland on a Presbyterian basis.

Mary Stuart's son, James VI, was reared a Presbyterian. When Queen Elizabeth of England died, in 1603, James inherited the throne of England. In England he was called James I. (*See* James, Kings of England; Stuart.) The two nations were thus united under a single king, but Scotland remained a separate state with its own parliament and government. There was no free trade between England and Scotland, and Scots were excluded from the profitable commerce with England's growing empire.

England tried repeatedly to impose on the Scottish "kirk" the English Episcopal form of worship and church government. The Scots took up arms against King Charles I; and when civil war broke out in England, they aided the Puritans against the king. However, when Oliver Cromwell executed Charles I, the Scots welcomed Charles's son in Edinburgh as Charles II. Cromwell then marched into Scotland and imposed his rule on the country (*see* Cromwell; Charles, Kings of England and Scotland). When Charles II was restored to the throne, persecution of Presbyterians continued. Finally, after James II had been driven from the throne, Presbyterianism was firmly established as Scotland's national church. The Highlanders long remained loyal to the exiled Stuarts. In 1715 they attempted to restore to the throne "James III," the Old Pretender; and in 1745 they supported the Young Pretender, "Bonnie Prince Charlie," famous in Scottish song and story (*see* Pretender).

Union with England

The ages-old rivalry between Scotland and England ended abruptly in 1707 when the parliaments of both nations agreed to the Act of Union. This act merged the parliaments of the two nations and brought the kingdom of Great Britain into being (*see* Great Britain).

Scotland now had free trade with England and the colonies. As Britain's empire expanded, the Scots played a very great part in its development. They shared also in the inventions that brought about the Industrial Revolution and in the wealth that flowed into Britain from it (*see* Industrial Revolution; Watt). The end of the 18th century was Scotland's most creative period. David Hume won world fame in philosophy and history, Adam Smith in political economy, and Robert Burns in poetry. In the next generation, Sir Walter Scott made the land and history of Scotland known throughout the world.

The history of modern Scotland is inseparable from that of England (*see* English History). Scotland, however, has special problems of its own, and a movement has grown up for some sort of home rule. The Scottish National party has as its object the setting up of a legislature for purely Scottish affairs. (For Reference-Outline and Bibliography, *see* Great Britain.)

SCOTT, ROBERT FALCON (1868–1912). On the 29th of March, 1912, three dying men lay in a little tent in the frozen Antarctic continent—three heroic men who had been to the South Pole. On their way back they had been caught by a terrible blizzard within 11 miles of a depot in which food and fuel awaited them. While the fearful gale beat and howled outside the flimsy shelter, their commander raised himself in his sleeping bag and feebly wrote these words: "We shall stick it out to the end, but we are getting weaker of course and the end cannot be far. It seems a pity but I cannot write any more.—R. Scott." Some time later he added the last entry, "For God's sake look after our people."

So ended in tragedy the English exploring expedition under Capt. Robert F. Scott which had gone out two years before with high hopes. They had reached the South Pole, indeed, on January 18, but not first. For Roald Amundsen, the Norwegian explorer, had arrived there on Dec. 16, 1911, a month earlier.

ROBERT FALCON SCOTT

This photograph of the heroic explorer was taken on the ill-fated expedition which cost him his life.

The story of the desperate struggle to cover the 1,800 miles from the pole back to their base, as told in Captain Scott's diary, is one of the most heroic and pathetic narratives in history. Soon after leaving the pole one of the party succumbed to the hardships. Then gallant Capt. Lawrence Oates became disabled. He could go no farther, and it meant death for his comrades to stay with him. Bidding them good-by, he walked out into the blizzard to his death

Even this sacrifice was in vain. When the survivors knew the end was near, Captain Scott wrote his imperishable farewell to England, in which he said: "I do not regret this journey, which has shown that Englishmen can endure hardships, help one another, and meet death with as great fortitude as ever in the past We have been willing to give our lives for this enterprise, which is for the honor of our country"

And to his wife he wrote "Make our boy interested in natural history if you can It is better than games Keep him in the open air Above all, you must guard him from indolence Make him a strenuous man The great God has called me. Take comfort in that I die in peace with the world and myself and am not afraid."

Scott entered the English navy at 14 as a midshipman In 1901 he headed an expedition to Antarctica in the *Discovery* and found Edward VII Peninsula His second and last expedition started in 1910 in the *Terra Nova*. Both expeditions accomplished much valuable research Captain Scott's records were recovered when his body was found eight months after his death. A cairn topped by a cross surmounts the last resting place of these martyrs of science. (*See* Polar Exploration.)

The SCOTS LAD *Who Became a* GREAT STORYTELLER

SCOTT, SIR WALTER (1771–1832). Both the poems and the novels of Sir Walter Scott are tales of exciting adventure. His ballads and 'Waverley' novels recount stirring incidents in the history of his own country, Scotland. Other novels go back to the Middle Ages in England or France. The writing is fresh and easy. The characters are kings, queens, statesmen, soldiers, farmers, beggars, and bandits. The reader feels that these people are living the sort of life he himself might have lived in the same time and place.

Scott is called the father of the historical novel because he set a pattern for this type of fiction that has been followed down to our own time. He had a wide knowledge of history; but he did not hesitate to take liberties with historical facts when they got in his way, because he was above all a storyteller.

Early Childhood and School Days

Walter Scott was born in Edinburgh Aug 15, 1771. His father was a lawyer in comfortable circumstances. Before Walter was two years old, he had an illness that left him lame for the rest of his life Scott later called the illness a "teething fever," but it was undoubtedly infantile paralysis.

The boy's parents thought country air would be good for him, so they sent him to his grandparents' farm, called Sandy Knowe. Here, on fine days, his nurse carried him out to the shepherd and laid him on the rocks around which the sheep were feeding. Walter began to crawl about, then to stand and walk. He was soon a healthy, high-spirited child. When he was six years old, an uncle gave him a small Shetland pony, no bigger than a Newfoundland dog, on which he could gallop over the countryside.

In the long days of winter, Walter's grandmother entertained him with ballads and stories of the Scottish border country. Some of the heroes were his own ancestors—"auld Watt of Harden," an ancient chieftain of the Scott clan, and Beardie, the boy's

own grandfather. These stories kindled his enthusiasm for history and romance. When he learned to read, he read voraciously. He liked particularly fairy tales, medieval legends, books of travel, and history.

When Walter was eight years old he was strong enough to return to his family in Edinburgh and to begin school. He was popular with the other boys because he was such a good storyteller and because he was always in the thick of "bickers," or street fights, between the boys of the school and the boys of the town. He also spent much time reading. During an illness, he arranged shells and pebbles to represent opposing armies of Scottish and English soldiers—

While, stretched at length
  upon the floor,
Again I fought each
  combat o'er,
Pebbles and shells in
  order laid,
The mimic ranks of
  war displayed.
    —'Marmion'

His teachers did not consider him a brilliant student because he was poor in Greek; but he learned Latin and enough French, German, Spanish, and Italian so that he could read his favorite authors in their own languages.

SIR WALTER SCOTT AT FIFTY

Scott was tall, fair, and handsome and still vigorous at fifty. This is an engraving after a portrait by Raeburn.

Becomes a Lawyer and Marries

For five years—from the age of 15 to 20—Scott worked in his father's law office as an apprentice. At 17 he began to study for the bar at the university and at 21 he passed his examinations. By this time he was a "braw" young man, tall and broad of shoulder. Because his clients were few, he had plenty of time to travel about the countryside with his friends, on foot or on horseback. Sometimes he walked 20 or more miles a day. He explored battlefields and the ruins of old castles and forts, made friends with country people, and learned their stories and their folk ballads.

While vacationing in the English Lake District, Scott met at a ball a beautiful young Frenchwoman, Charlotte Carpenter (originally Charpentier). Her father, a French royalist, had died during the French Revolution, and the mother had taken her children to safety in England. A few weeks after meeting Charlotte, Scott wrote to his mother: "Without flying into raptures, I may safely assure you that her temper is sweet and cheerful, her understanding good, and what I know will give you pleasure, her principles of religion very serious." The marriage took place a few months later. Scott was then 26 years old.

CHIEF EVENTS IN SCOTT'S LIFE

1771.	Born at Edinburgh August 15
1778.	Enters high school at Edinburgh
1783.	Matriculates at Edinburgh University
1786.	Enters his father's law office as apprentice
1792.	Admitted a member of the faculty of advocates
1797.	Married, Christmas Eve, to Charlotte Carpenter
1799.	Appointed sheriff-deputy of Selkirkshire
1805.	Publishes 'Lay of the Last Minstrel'
1812.	Begins building Abbotsford
1814.	Completes and publishes 'Waverley'
1820.	Created baronet
1826.	Ballantyne firm fails; leaves him owing $650,000
1832.	Dies September 21; buried at Dryburgh Abbey

At 28, Scott was appointed sheriff-deputy of Selkirkshire. This post, added to his earnings as a lawyer, gave him a comfortable living. He continued to collect ballads, and in 1802 he published the first two volumes of his collection, called 'Minstrelsy of the Scottish Border'. The third volume appeared the next year.

In 1805 appeared Scott's first great romance in verse, 'Lay of the Last Minstrel'. The astounding success of this book determined Scott to make literature his main business. But he continued to perform his duties as sheriff and even took another well-paid office, that of Clerk of Session. So great was his capacity that he was able to attend to his law duties and in addition turn out an enormous volume of literary work. He edited the works of Dryden, Swift, and other writers and contributed to various periodicals. For relaxation, he wrote 'Marmion' (1808), his finest poem. Many of the warlike scenes of 'Marmion' —particularly the battle of Flodden—he composed while galloping on horseback over the countryside. 'The Lady of the Lake', another verse romance, appeared in 1810. Scott was now by far the most popular of English poets; but he foresaw that in the next few years his popularity was to be overtaken by that of a greater poet, Lord Byron.

In 1812 Scott bought a "mountain farm" on the River Tweed and moved there with his wife and four children. He named the place Abbotsford. It became his great delight to add to the house, buy more and more land, and cover the land with trees. He also liked to collect old books and armor. He kept the doors of Abbotsford open and entertained swarms of guests.

Turns from Poetry to Prose

One day Scott chanced to find, tucked away in an old desk in the garret, the first chapters of a historical novel he had begun years before. He speedily finished the story and published it in 1814 as 'Waverley; or 'Tis Sixty Years Since'. Its amazing success prompted him to write a series

of 'Waverley' novels. He published the books anonymously, perhaps because of his love for mystery. Not until 1827 did he admit authorship of the 'Waverley' series. Meanwhile he continued to write under his own name a flood of stories, historical works, and articles. In 1820 George IV conferred on him the title of baronet. Thereafter his name was written Sir Walter Scott, Bart.

At 43, when 'Waverley' was published, Scott was at the height of his powers. He would rise at five o'clock, dress himself in breeches and shooting jacket, and be in his study by six, where he worked with great concentration until nine or ten. He wrote very rapidly. The study door was always open, and his dogs were always near his feet. He had to feel the life of the house going on about him as he wrote. At ten o'clock he breakfasted with all his family. His daughter Sophia was 15 at this time; Walter was 13; Anne, 11; and Charles, 9.

Scott in Adversity

But disaster hung over this happy household. In 1809 Scott had become an inactive partner in a publishing firm founded by his friends James and John Ballantyne. The Ballantynes were not good businessmen; and Scott, always pressed for money, was continually asking for advance payments on his books even before they were written. In 1816 Scott had to borrow heavily from a friend to tide the business over. In 1826 the crash came. His wife died in the same year. Because Scott was a man of the highest standards of honor, he accepted his share of the firm's debts—about $650,000—and at the age of 55 set to work with a fury of energy to repair his fortunes and pay his creditors. Before his death he paid off about $200,000. The rest of the debt was cleared 15 years later by the sale of his copyrights.

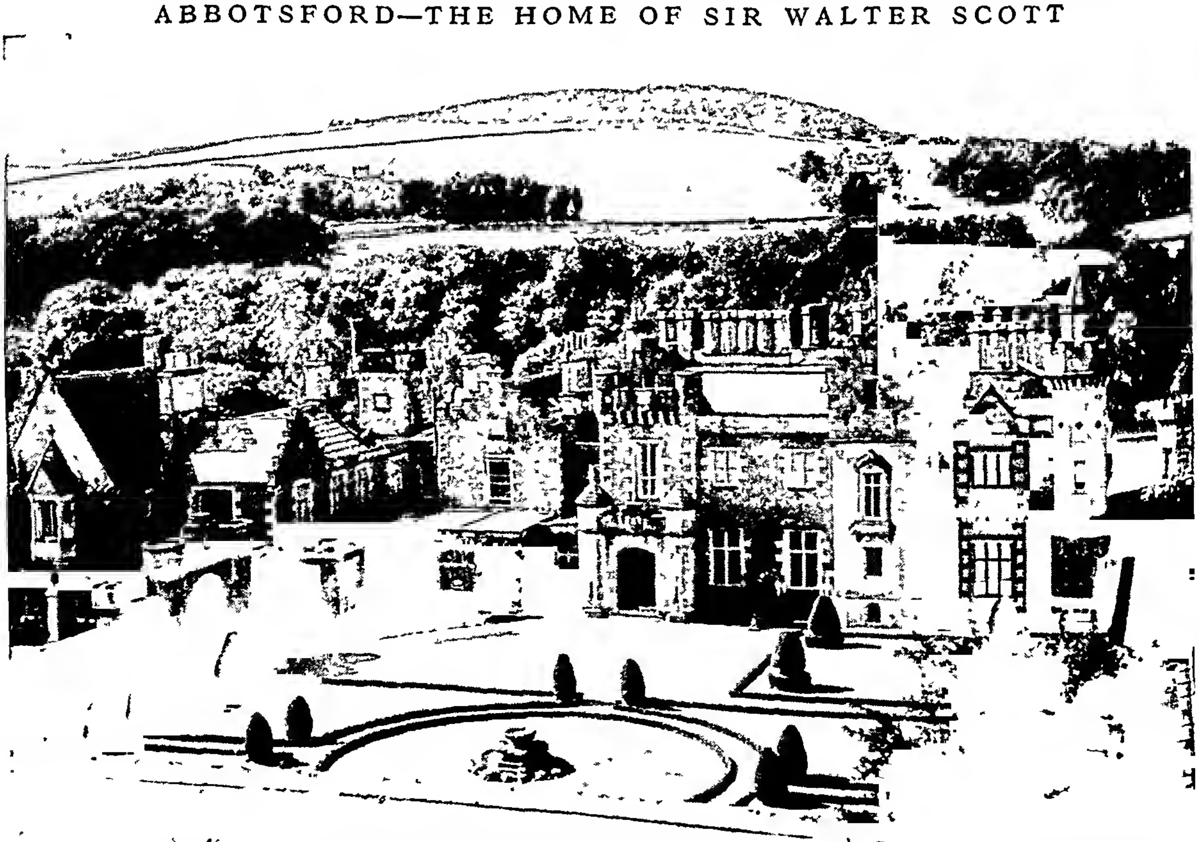
Superhuman work finally broke Scott's health. At 60 he was old and feeble. In 1831 he sailed as a guest of the British government in the frigate *Barham* to the Mediterranean in search of health. But he grew worse, and he was very homesick for Scotland. He was brought back to London, sailed from there to the Firth of Forth, and finally reached Edinburgh. In the great biography of Scott by his son-in-law, John Gibson Lockhart, the account of this journey home is a deeply moving story. Scott died at Abbotsford Sept. 21, 1832, and was buried with his ancestors at Dryburgh Abbey.

Critical Estimate of the Novels

Scott's soundest critics disagree as to which of his novels is the best. His own favorite was 'The Antiquary', a comedy of Scottish life. The characterization in this book is for the most part superb, though the plot is weak.

Robert Louis Stevenson said that 'Waverley' had the best plot of all the novels. It was written to

ABBOTSFORD—THE HOME OF SIR WALTER SCOTT



In 1811 Scott bought a small farm and cottage called "Clarty Hole." He renamed it Abbotsford because the land had belonged to the abbots of Melrose and it was near a ford across the Tweed. Year after year he added to the house until it became a castle.

reveal Highland and Lowland Scots to Englishmen. 'Guy Mannering'—nearly always included in any list of the finest—is a drama splendidly worked out, and Meg Merrilies is an excellent portrayal of a figure from the Scottish underworld. Most critics agree with John Buchan that 'Old Mortality' "rises to scenes of tragic intensity which Scott never excelled, and contains figures of the most masterful vitality."

'Ivanhoe', though not the best, is certainly the most popular of all Scott's works because of its exciting plot. Most of the action takes place in England in the time of the Crusades. There is a brilliant description of a tournament in which Ivanhoe, aided by Richard the Lion-Hearted, defeats all the knights of Richard's brother John. Among the famous characters in the book are Robin Hood, Friar Tuck, and Rebecca, daughter of Isaac, the Jew.

'Kenilworth' gives a masterful portrait of Queen Elizabeth I and glimpses of her court, where young Walter Raleigh is coming into favor. It takes liberties with history in order to combine in one magnificent drama both the splendor and the crimes of the period. 'The Abbot' gives a wonderful portrayal of Mary Stuart of Scotland. At least two other novels rank high. 'Quentin Durward' is about a young Scotsman who flees from the feuds of his family and finds adventure in the spider-web intrigues at the court of Louis XI of France. 'The Heart of Midlothian' has a Scottish theme. It contains a memorable scene in which Jeanie Deans pleads with Queen Caroline for the life of her half sister Effie.

There are some people who do not like to read historical novels in which history is altered for dramatic purpose. One might say that Scott is not for them, were it not that the interest of his stories lies in the people—whether they are personages from historical records or people of the author's imagination. Only Tolstoy compares with Scott in this power of bringing men and women from history into books and treating them, not as puppets, but as creatures of flesh and blood. Scott never forgets that history is made by the clashes and conflicts of men and women.

Books by and about Scott

Among Scott's chief works are: 'Lay of the Last Minstrel' (1805); 'Ballads and Lyrical Pieces' (1806); 'Marmion' (1808); 'The Lady of the Lake' (1810); 'Waverley' (1814); 'Guy Mannering' (1815); 'The Antiquary', 'Black Dwarf', 'Old Mortality' (1816); 'Rob Roy' (1817); 'The Heart of Midlothian' (1818); 'The Bride of Lammermoor', 'Ivanhoe' (1819); 'The Monastery', 'The Abbot' (1820); 'Kenilworth' (1821); 'The Pirate', 'The Fortunes of Nigel' (1822); 'Peveril of the Peak', 'Quentin Durward' (1823); 'Redgauntlet' (1824); 'The Betrothed', 'Talisman' (1825); 'Woodstock' (1826); 'Fair Maid of Perth' (1828); 'Count Robert of Paris' (1832). Good biographies are H. J. C. Grierson's 'Sir Walter Scott, Bart.', E. J. Gray's 'Young Walter Scott', and J. G. Lockhart's 'Memoirs of the Life of Sir Walter Scott'.

SCOTT, GENERAL WINFIELD (1786–1866). "Old Fuss and Feathers" was the nickname the soldiers gave to Gen. Winfield Scott because he was such a lover of formalities. In spite of this, Scott was for years the foremost military man in the United States.

A Virginian by birth, Scott studied law at William and Mary College. He practiced this profession for only two years. In 1808 he became a captain in the army and gained fame in the War of 1812 and in the Mexican War. By the end of that first war he had been made a major general because of his services in the battles of Chippewa and Lundy's Lane. In the Mexican War his victorious march from Vera Cruz to Mexico City made him a national hero. He was nominated for the presidency by the Whig party in 1852 but was defeated in the election. In 1852 the rank of lieutenant general was given him by Congress.

Scott performed many other important services. At the close of the Black Hawk War he negotiated the treaties with the Indians. He removed the Seminoles from Florida and Georgia. In the so-called Aroostook War, when the settlers of Maine and New Brunswick quarreled over the boundary line, he was sent to preserve peace. In a similar controversy in the Northwest over the occupation of the island of San Juan north of Puget Sound he performed a similar service.

When the Civil War broke out Scott was general in chief of the army. He was now 75 years old, and a younger man was needed to meet the situation; so after planning for the defense of Washington he laid down his command Nov. 1, 1861.

SCRANTON, PA. Each of Pennsylvania's four corners has a metropolis. Philadelphia, Pittsburgh, and Erie stand in three corners, and in the northeast, on the Lackawanna River, is Scranton, the fourth largest city in the state. In earlier years, rich coal veins nearby gave it the nickname the Anthracite Capital of the World. But the veins have been worked out and now the city is chiefly a coal-shipping and manufacturing center.

Ready access to raw materials, good transportation facilities, and a large labor supply have brought a wide variety of industries to Scranton. More than a hundred factories produce chemicals, furniture, household appliances, plastics, textiles, tobacco products, and other goods. It has the largest Nottingham lace mill in the country. For many years Scranton ranked as the second American city in silk manufacturing. Its silk mills are now largely converted to production of nylon and rayon textiles.

The city is the site of the University of Scranton, Marywood College, and the well-known International Correspondence Schools. It has its own Philharmonic Orchestra. Nay Aug, the city's outstanding municipal park, has a miniature coal mine and the Everhart Museum of Natural History, Science, and Art.

Scranton was settled in the middle 1700's. Its real growth dates from 1840, when George and Selden Scranton built a forge to make iron using the nearby anthracite as fuel. It was chartered as a city in 1866. It is governed by a mayor and a council. Population (1950 census), 125,536.

SCULPTURE—*A Record of* HUMAN EXPERIENCE

SCULPTURE. 'The Burghers of Calais', by Auguste Rodin (*rô-dăṅ'*), is a monument to French dignity and courage. At the same time this poem in bronze is a monument to the genius of its sculptor, the greatest since Michelangelo.

The historic moment expressed through the six figures is one of trial and triumph. The year was 1347; the place, outside the gates of Calais, the port town of many an invasion. The English, led by their king, Edward III, had laid siege to the town and starved it into submission. The terms for surrender required that six men come "in their shirts and with halters about their necks" to deliver the keys of the town and castle.

The fate of these men was clear. They were to pay the penalty for resistance, but in delivering themselves they would assure safety for the rest of the town. France remembers the name of the man who volunteered first, Eustache de St. Pierre, the richest burgher of the town.

It was to the memory of this one patriot that in 1884 the grateful people of Calais ordered a statue. In working out the idea, however, Rodin was so moved by the incident that he added the five volunteers who chose to accompany the leader. For this he asked and received no more than the sum of money agreed upon for the one figure. Four years after beginning this work, Rodin had given form to his idea and had cast it in bronze.

How Rodin Achieved Unity and Drama

There is no mistaking the leader, Eustache de St. Pierre. Rodin gives him an erectness and poise born of daring and determination. In his hands is the key to the city and around his neck is the rope, or halter, prescribed by the conquerors. A young companion, whose head is buried in his hands, may be seen just behind his shoulder, on the right. These two men exemplify the greatest contrast of feeling in the group. By placing them together Rodin achieves dramatic power. Observe too that this use of contrasting emotion is strongly evident in the central group and to a lesser extent even in the two figures on the left.

To organize, or compose, six different figures into a single unified work of art, Rodin groups them into three pairs, each pair differing from the other and yet tied to the otheıs in rhythmic movement. The view we see shows not only the variety of gesture and body angle in each of the pairs, but how monotony is avoided by joining the right and central groups. The space allowed between these four and the two figures on the left is a welcome interval but not an empty one, for into it is thrust a hand which is both eloquent of despair and effective as a connecting rhythm. The spaces between the figures are as varied as the figures themselves. This is, of course, what all good sculpture tries to achieve, for *sculpture deals essentially with the purposeful relationships of volumes in space.*

If we now look at the details we may see Rodin's extraordinary ability to convey feeling through facial expression and through hands. See how deeply he cuts the hollows of the face to assure strong shadows and how his textured surfaces catch the subtle variations of light and heighten the sense of life and movement

It is this irregular surface, so deftly achieved in the original clay, that links Rodin to the impressionist painters of his time. By departing from the cold, impersonal smoothness of the classical tradition, he gave to his surfaces the shimmer of light which characterized the paintings of the impressionists (*see* Painting). Together with a profound sense of power and drama, this characteristic of Rodin had a tremendous influence on the sculptors of his time and helped to determine the trend of sculpture of our own day. (*See* Rodin; *also* subhead "The 20th Century," in this article.)

The Purpose of Art

To make this masterpiece there had to be an incident; there had to be a sculptor; and there had to be the materials and technical knowledge with which the sculptor could give the meaning of the incident tangible form in bronze. And yet the townspeople of Calais would have wasted their money and Rodin would have failed in his ultimate purpose if this great work were never to be seen after its completion.

This is another way of saying about the 'Burghers of Calais' what is true for all sculpture and for works of art of all kinds. *Art is a means of organizing experience into ordered form.* The experience thus translated into statue, song, painting, or poem can then come to life again in the consciousness of other people. It may truly be said that only when this sharing takes place has a work of art been fully realized. That is why art is properly regarded as a language, and we may rest assured that artists, like other people, would rather not be talking to themselves.

To understand the artist's language, however, requires a little effort. Looking at a work of art, like listening to music, becomes a rewarding experience only if the senses are alert to the qualities of the work and to the artist's purpose which brought them into being. Beyond that, one's own background of experience will determine how little or how much one can share in the experience which the work of art embodies.

The language of sculpture, then, must be learned as surely, and perhaps as slowly, as any spoken language. The thought behind the foregoing analysis of the 'Burghers of Calais' is that it might serve as a way of seeing sculpture, and of learning the language.

The Scope of Sculpture

Sculpture, like other arts, is a record of human experience. From earliest times to our own day, sculpture records experiences that range from wars and worship to the simplest joys of seeing and touching suspended shapes designed to move in the wind. In sculpture there is everything from the marble gods of

'THE BURGHERS OF CALAIS', BY AUGUSTE RODIN

This bronze cast (top), one of four, stands outside the Rodin Museum in Philadelphia. The first cast from the original mold is in Calais, France. Shown also are details of two of the heads. The aged burgher (right) was photographed at night by flashlight. The young man (left), shown in sunlight, is the figure hidden behind the left of the group.

PRIMITIVE AND ANCIENT SCULPTURE

Above are two 18th-century African knives; an effigy water jug from Peru, dated about A.D. 200; a terra-cotta whistle, Panama (left of jug); a 19th-century Northwest American Indian rattle, Alaska (below jug); and bronze weights from the African Gold Coast. (University of Pennsylvania Museum, Philadelphia.)

Phidias to the mobiles by Calder. Everywhere and always man has found the need for sculpture, whether it be in his work, in play, or in prayer. The lively, colorful objects from the University of Pennsylvania Museum show that even to store water, weigh merchandise, fight battles, "rattle" the spirits, or whistle a tune, man used sculpture.

Sculpture also records our will to honor and be honored, to commemorate the deeds of nations and individuals. To achieve this we sometimes move mountains, so to speak, as exemplified in our two illustrations (next page) of colossal figures cut from living rock.

Tradition in Sculpture

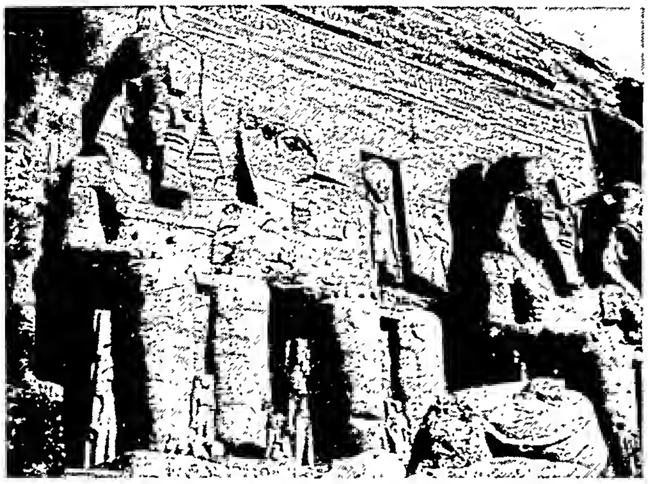
Each period in art is a link in the golden chain of creative achievement. This means that a sculptor today has at his command the fine examples and techniques left him as a heritage by his predecessors. If he uses them to sharpen his own vision, to deepen his own insight, and to solve his own problems, we say he uses tradition creatively. Those who merely imitate the approved styles of the past are said to be academic. Between the two is the eclectic. He borrows a little here, a little there, but never puts his roots down deeply anywhere.

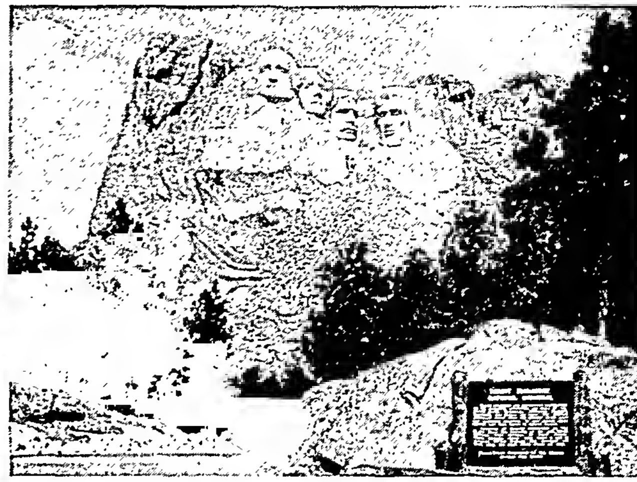
Needless to say, in so brief a survey of the world of sculpture, we must limit ourselves to the creative use of tradition. For this we now refer to three versions of the Madonna and Child, one by an unknown carver of 12th-century France, the others by two contemporaries working in England.

This painted limestone head shows Nofretete, wife of King Akhenaton and mother-in-law of Tutankhamen. She lived about 1,350 years before Christ. The head was found at Tell el-Amarna, Egypt, in 1912. (Staatliche Museum, Berlin.)

The painted wood statue (Chinese Sung Dynasty, 12th century) is the Bodhisattva Avalokitesvara, the ancestor of the Tibetans. The Dalai Lama is believed to be an incarnation of this Buddhist god. (Boston Museum of Fine Arts.)

SCULPTURE MAY HONOR MEN ON A COLOSSAL SCALE





On the Temple of Abu Simbel, Egypt, four figures of Rameses II are carved out of the rock. Sculptured on the face of Mount Rushmore, South Dakota, are the heads of Washington, Jefferson, Theodore Roosevelt, and Lincoln, by Gutzon and Lincoln Borglum.

The French example has the graceful rigidity of all medieval sculpture. Except for the placement of the Virgin's hands the figures are so symmetrical that a line suspended from top to bottom would give almost identical halves. In this symmetry and in the decorative flow of the drapery this engaging work carried on the tradition of ancient art. Egypt, Greece, India, and China shared this stylized approach for great periods of time. Moreover, in medieval Europe, as in the earlier cultures, religion was the source of style, subject matter, and inspiration.

Jacob Epstein (born 1880), unlike the medieval sculptor, was free to do as he wished without concern for established rules of style and symbolism. In his 'Madonna and Child' he retains the rhythmic curves, the quiet poise, the serious dignity of expression found in medieval art but uses these only as a point of departure. The curves are not rigid but varied and easy flowing. The quiet poise is now charged with deep emotion, and the expressions on both faces come from deeper than the surface of the bronze.

The 'Madonna and Child' by the English sculptor Henry Moore (born 1898) is extraordinary in this respect: on the one hand the simplification and distortion of body and limb seem extremely daring departures from the past; on the other hand, they are reminiscent of the earliest sculpture ever produced. Moore succeeds in integrating primitive and ancient traditions with those of his contemporaries. Thus he has created a new form.

THE MADONNA AND CHILD—A FAVORED SUBJECT THROUGH THE CENTURIES

The French figure (left), of polychromed oak, is by an unknown medieval sculptor, school of Auvergne, France (Metropolitan Museum of Art, New York City). Two modern treatments of the Madonna and Child are Henry Moore's cement figure (center), in the Church of St. Matthews, Northampton, England; and Jacob Epstein's bronze figure, owned by Sally Ryan of New York City.

Religious serenity and pronounced pattern are clearly visible, but the pattern is greatly simplified, as in the lower folds of the Virgin's garment. Masses too are treated with a lumplike simplicity. And giving grandeur to both the mass and the pattern is the quality associated with the colossal deities of stone in Egypt and in the Far East. This Moore achieves not by sheer size but by relationships within the given height, which is only 59 inches. From the broad, enormous-looking legs to the smaller body, and then to the surprisingly small head we get the impression of looking up to a great height. In art this alteration of the literal truth to achieve a desired effect is called *distortion.*

Lighting and Point of View

Light can make or ruin sculpture. While working on a statue, the sculptor relies on proper light to study the planes by which masses gradually or suddenly turn from the light into the shade, creating the sense of solidity and third dimension. Only by light properly cast can he study shape, texture, and character.

The sculptor strives to show his finished work in the same light by which he worked originally. A light cast too weakly or too strongly from a source too high or too low can undo the effort of the sculptor and destroy the effectiveness of his creation.

The pictures of the bust of Robert Frost by Walker Hancock (born 1901) show how the character of the face is changed by lighting. Overhead lighting at the proper level reveals form and a balanced proportion of subtlety and strength, gentleness and vigor. Here the man is seen as a friendly person, full of the sentiment of his own poetry. A side light, strong and close, creates a sense of power and drama and reveals somewhat different qualities. He appears more lofty. His gaze becomes profound and mellow. Lighting from a source below eye level (not shown) would destroy much of the form and almost all the character.

Paintings too depend on light but not in the same sense as sculpture. The painter asks only that the whole surface of his picture should receive uniform and sufficient light for proper viewing. The light and shade he uses on a face or figure to give it roundness and solidity cannot be altered by an external light. In sculpture, on the other hand, volume and character are brought to life only through light and can be altered at will by the control of light. Proper lighting at night of a statue placed out of doors also requires skill.

Sculpture differs from painting in another significant respect. A painting, being flat, can show only the view taken by the painter. A statue in full round can be seen from a variety of angles. Consequently the sculptor strives to be his best at any angle and to achieve sense and rhythm for every possible point of view. Sculpture is thus endowed with a variety of interest impossible in painting.

Materials and Processes

To fashion sculpture man had to learn the use of certain materials and to develop appropriate tools and processes.

HOW LIGHTING AFFECTS SCULPTURE

These two views of Walker Hancock's bronze bust of the poet Robert Frost illustrate how overhead lighting (left) and strong, dramatic side lighting (right) change the character of the face

Carving is the process of reducing substances such as stone, wood, or ivory to a desired shape by cutting or chipping away unnecessary parts. The earliest carvings were probably nothing more than figures scratched into the flat surface of a rock. As time went on primitive sculptors discovered that by cutting away the background surrounding the figure, the animal or other figure appeared more real. This was the beginning of *relief* sculpture. Sculpture in which the figures extend from the background less than half of their natural volume is called *low relief.* That which extends beyond this point is called *high relief,* and sculpture that stands completely away from its background is said to be in *full round.*

Carving requires a sure knowledge of the final form desired, for a material such as marble or granite cannot be restored once it is cut off. To lessen the risk of error sculptors often make small models in clay, wax, or plasticine, scaled to proper proportions, before undertaking the final carving. Sometimes a *pointing machine* is used to help transfer the exact contours of the model to the final stone. This machine, which mounts a movable needle, transfers to the final material a series of points corresponding exactly to those made on the model. With this mechanical guide the sculptor knows just where to carve.

Until about the end of the Renaissance in Italy sculptors did their own final cutting in the stone. Today the sculptor contents himself with working out a detailed scaled model and entrusts the final work to trained studio assistants and stonecutters.

The sculpture of Egypt, Mesopotamia, Greece, China, and Europe of the Middle Ages was generally given a painted surface, known as *polychromy.* First a thin coat of plaster (gesso) was applied over the wood or stone and over it were painted bright colors to help give a greater sense of realism.

Modeling is the process of manipulating plastic materials such as clay, wax, or plasticine. Clay has been used for ceramics and sculpture since earliest times.

SUMERIAN ART, 2400 B.C.

This head of Gudea, prince of Lagash, is cut in gray-black diorite. It has the smooth perfection and idealized features of the classical period in Sumerian art. (The Louvre, Paris.)

It is widely available and easily shaped, baked, and glazed. Baked clay, known as terra cotta, glazed and unglazed, was used with great artistry by ancient and primitive peoples.

Types of Casting

Casting is the process by which a piece of sculpture is reproduced through the use of a mold. A plaster mold consisting of two or more tightly fitting parts is made over or around the original clay model. When it is hard, the mold is removed, cleaned, oiled on the inside, and reassembled. Through an opening left for the purpose a creamy mixture of plaster and water is poured into the mold, and the mold is gently rolled so that the plaster is distributed evenly over the inner surface. The excess is poured out and the process is repeated until the desired thickness is achieved. When it is dry, this newly formed plaster shell is freed by chipping away the outer mold. The result is a perfect replica of the original model. Because the original clay model and the mold are both destroyed in the process, this is known as a *waste mold*.

The plaster cast can now be given a desired surface quality by paint or shellac or can be used as a model for further casting in more durable materials such as bronze and other metals, terra cotta, and cement. More complex molds, which permit more than one replica to be produced, must be used for this purpose. Thus it differs from the waste mold.

The casting of metals requires special skill and great care. Bronze has proved to be the most versatile metal for casting. The two principal methods are the *sand mold process* and the *lost-wax* (*cire-perdue*, in French) *process*. The first uses a specially prepared sand mold, the second a silica mold.

Both molds have an inside *core*, so built as to leave a thin space between itself and the outer mold. The outer contour of this space bears the exact contour of the original cast from which the mold was made. When hot liquid bronze is poured into this space it takes the shape of the original plaster, thus resulting in a perfect reproduction. The space in the silica mold is filled with wax until it is melted out by the hot bronze, hence the name lost-wax process. This is the process made famous by Benvenuto Cellini and so skillfully practiced by many ancient peoples, especially the Chinese. (In the article Bell is a drawing which helps us to understand how casts are made.)

Patina is the term used for the surface color and quality of bronze and other materials. Without waiting for time, use, and atmospheric conditions to give a lovely surface to sculpture, artists use acids, heat, and other devices to achieve immediate effects of mellowness, age, and subtle color.

And now, having indicated an approach to the understanding of sculpture, we will undertake a brief survey of its history.

Sculpture among Primitive Peoples

The earliest club wielded by the cave man was no great work of art, but because he shaped it into purposeful form it was sculpture of a kind. The gods that primitive man created in his fear and faith required a form as tangible as the club, though more complex. The earliest worshipers could not cope with abstract ideas of their gods. They had to see, touch, sacrifice to, and sometimes punish them.

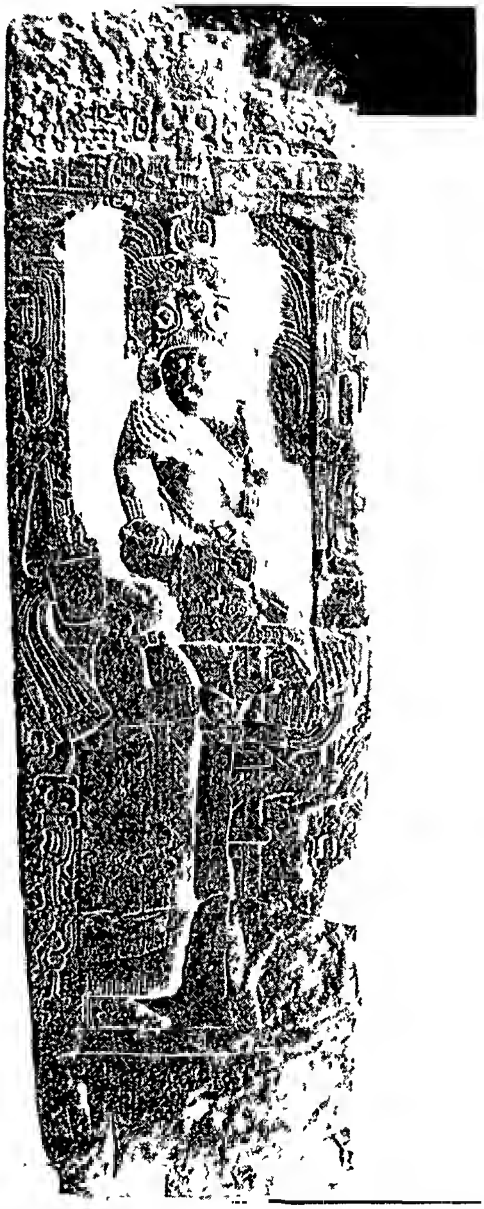
In Polynesia and Peru, in southern France, New Zealand, Africa, Alaska, and Mexico we find evidence that sculpture entered into every form of primitive life. Many of these early objects are fascinating in their strangeness and beautiful in their design. Modern artists, seeking new and virile forms of expression, have found a rich fountain of inspiration in these crude but serious efforts of early man.

MODERN ARTISTS REFLECT PRIMITIVE INFLUENCES

Amedeo Modigliani's stone head (left, Museum of Modern Art, New York City) and the African mask (right, University Museum, Philadelphia) show how a modern artist uses primitive styles creatively.

Amedeo Modigliani (*mō-dē-lyä'nē*) (1884-1920), for example, was so impressed with the simple, bizarre pattern of African Negro sculpture that he made creative use of it in his own work. The elongation of the head and the geometric simplicity of facial features are influences from such masks as the fine one illustrated on the preceding page. This mask, from Africa's Ivory Coast, was designed to be worn during religious ceremonies, and its pattern was conditioned by that purpose. Modigliani, on the other hand, is interested in creating a feeling of simple, solid elegance, touched with the mystic silence found in the stone carvings of medieval saints. Consequently he joins the two traditions in an original creation. On our own continent sculpture thrived long before the arrival of Columbus. We have already seen examples of work from Peru, Panama, and Alaska on page 72. The Tarascans and Aztecs of ancient Mexico and the highly gifted Mayas of Central America rank high in Pre-Columbian sculpture.

A MAYAN STELE FROM GUATEMALA



This stone pillar shows a priest in ceremonial headdress. Hieroglyphics record the date of its dedication and prophesy the future. It was carved about A.D. 750, probably with flint tools.

Among the most interesting finds in recent times are the limestone carvings at Piedras Negras, in Guatemala. Here in front of high, stepped pyramids once surmounted by temples, stood large pillars, or stele, carved with figures and symbols of religious significance. Typical of these is the one pictured on this page. Here the priest, wearing his ceremonial headdress, is shown seated during a religious ceremony. Hieroglyphics on both sides of the stele record the date of its dedication and prophesy the future.

The Art of Egypt and Mesopotamia

As far back as 5,000 years ago Egypt had introduced a style which, with surprisingly little change, continued for almost 3,000 years. Rules for the making of statues were rigidly prescribed, as were social and religious customs. Religion was the dominant force in life on earth and it required certain preparations for the life beyond. Sculpture was entirely associated with the needs of religion and the gods or with the earthly rulers who were regarded as their representatives. (*See* Egypt, Ancient.)

To symbolize the godlike role of the kings, they were represented as half human, half animal. The great Sphinx at Gizeh is the best known example. To express their power and eternal life they were carved in the hardest stone and in colossal proportions. An example is the statues of Rameses II (page 73).

Of the many treasures excavated in Egypt the beautiful limestone head of Queen Nofretete (page 72) is one of the finest. The breath of life seems to animate the face. The painted, subtlely modeled surface and graceful flow of neck and features create a sense of startling realism. Sculpture flourished until Egypt was conquered by the Persians, Greeks, and Romans.

More than 4,000 years ago the valleys of the Tigris and Euphrates rivers began to teem with life—first the Sumerian, then the Babylonian, Assyrian, Chaldean, and Persian empires. Here too excavations have unearthed evidence of great skill and artistry. From ancient Sumeria have come examples of fine works in marble, diorite, hammered gold, and lapis lazuli. Of the many portraits produced in this area, some of the most pleasing are those of Gudea, prince of Lagash, an example of which is shown on page 75. Some are in marble, others, such as the one in the Louvre in Paris, are cut in gray-black diorite. Dating from about 2400 B.C., they have the smooth perfection and idealized features of the classical period in Sumerian art. The turbaned head, large eyes, and small mouth are characteristic of the period.

Babylonian and Assyrian sculpture is impressive in its vitality, massiveness, and rich imagination. Huge fanciful lions or winged bulls with human heads stood guard at palace entrances. Inside, the walls were

GREEK SCULPTURE ESTABLISHED THE CLASSICAL TRADITION

Praxiteles' 'Hermes with the Infant Dionysus' is the only known original by an early Greek master. It was unearthed in 1877 at Olympia, Greece, and is in the Olympia Museum. The missing arm probably held a bunch of grapes, toward which the child is reaching. In the Louvre, in Paris, is the 'Victory of Samothrace', named for the island in the Aegean Sea where it was found in 1863.

carved with scenes of royal hunting parties, battles, and festivities. (For pictures, *see* Babylon; Babylonia and Assyria.) In Persia too, especially at Persepolis, fine sculpture was produced (*see* Persia).

The Glorious Sculpture of Greece

The glory of Greece was its sculpture. Its rapid and phenomenal achievement in this art remains unequaled. The roots of Greek sculpture reach into the earlier cultures of Crete, Mycenae, and even Egypt. The figures of the 7th and 6th centuries B.C. lack life and movement; their faces wear the frozen smile peculiar to archaic sculpture. Even so, these early craftsmen, whose names are lost with the temples they decorated, show sensitivity to the qualities of marble and a superb sense of design. As if to make up for the lack of life in their statues, archaic sculptors sought naturalism by painting them.

Greek sculpture rose to its highest achievement in the 5th century B.C., when the spirit of Greece itself was at its height. Of the temples built in this "golden age" of Pericles, the finest was the Parthenon, dedicated to Athena, goddess of Athens. It was ornamented by the master of Greek sculpture, Phidias. (*See* Acropolis; Greek and Roman Art; Phidias.)

Phidias could not possibly have done all the marvelous sculptures of the Parthenon, and only here and there can one be sure of the master's own hand. 'The Three Fates', designed to fit the triangular space of the pediment, is outstanding. (For picture, *see* Greece.)

Two contemporaries of Phidias were Myron and Polyclitus. The works of these two men are known to us through Roman copies only, but in the 'Hermes with the Infant Dionysus' by Praxiteles (born about 380 B.C.) we have an original of idealized beauty.

In the Louvre, in Paris, stands the famous 'Venus de Milo', found in 1820 on the island of Melos. The sculptor is unknown. (*See* Aphrodite.)

The same museum possesses the 'Victory of Samothrace', also known as 'Winged Victory'. A Nike, the name given to the goddess of victory, she is believed to have been made in celebration of a great naval victory, perhaps the one at Salamis in 480 B.C. The forward push of her body, with wings and draperies flying in the wind, recalls the Nikes that adorned the prows of ancient ships.

This statue is of the late period following the Macedonian invasion under Alexander the Great (4th century B.C.). Exaggerated gestures and an overabundance of decorative detail replaced the quiet dignity and restraint of earlier days. Under Alexander's expanding rule, however, other Mediterranean countries and even the Orient came in contact with the genius of Greek art. Although it had come to an end in its own land, the spirit of Greek sculpture was to live again in Rome, in the Renaissance, and in several other periods about to be described.

From the Romans to the Renaissance

The Romans lacked the intellectual and aesthetic sensibilities of the Greeks. Their strength lay in mili-

tary prowess, engineering, road building, and lawmaking. Their emperors required realistic portraits and triumphal arches to impress their own people and the subjugated nations of their far-flung empire.

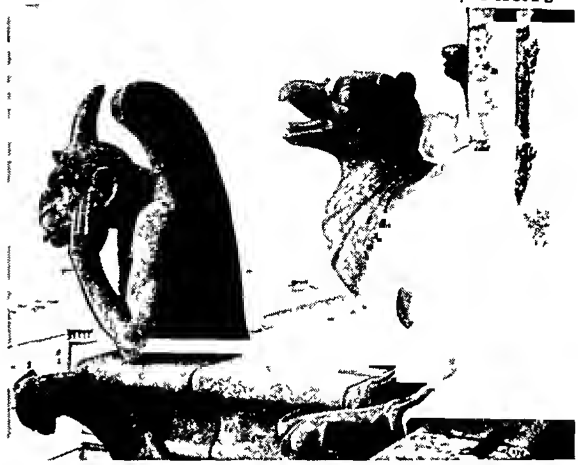
The triumphal arches of the Emperors Titus and Constantine, adorned with scenes of victory and battle, have inspired similar efforts in Europe and America, from the Arc de Triomphe, in Paris, to the Memorial Arch of Valley Forge. By the 2d century A.D., however, Rome and sculpture both had lost their vigor. It should be said for the Romans that as collectors, copyists, and imitators of Greek sculpture, they handed on to later generations the partial fruits of Greek labor.

In the 4th century the Roman Empire officially accepted Christianity as its religion. This meant a new way of life and consequently a new kind of art. Sculpture, like painting, music, and philosophy, turned for inspiration to the church, and the church, confronted with the need of interpreting the new religion for great masses of people, used the arts to good advantage. The vast majority of people could not read, and sculpture and painting became their books.

Art was austere, symbolic, and otherworldly from about 500 to 1500, the period known as the Middle Ages. Completely religious in subject matter, sculpture was closely related to church architecture.

Architecture in the Middle Ages developed two distinct styles: Romanesque and Gothic. Romanesque architecture, with the sculpture which decorated it, was born in Italy and derived its name from its similarity to the weighty monumental quality of Roman

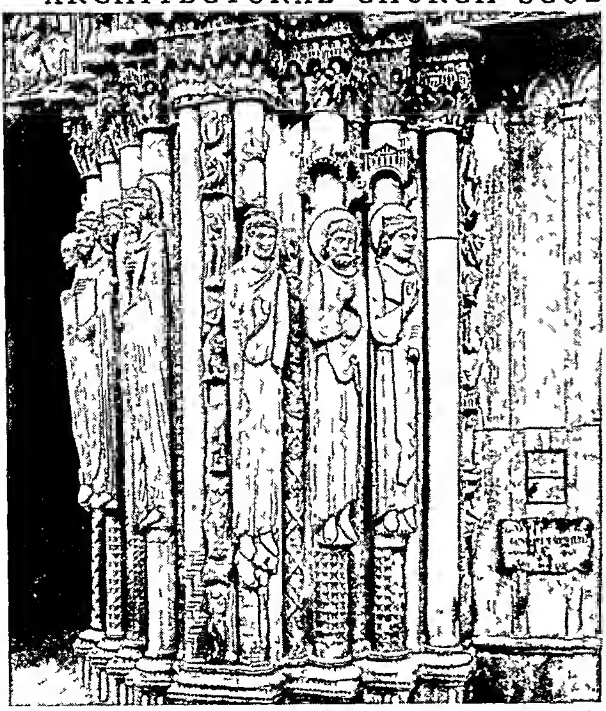
CHIMERAS OF NOTRE DAME, PARIS



Fanciful figures known as chimeras stare over Paris from the roof of Notre Dame Cathedral. Imaginative creations, they were intended to frighten people into mending their ways.

buildings. Late in the 12th century a new style was being developed in France, destined to spread to every Christian country and even as far as the Holy Land in the times of the Crusades. With its pointed arch and slender, lofty spires, it led to such architectural marvels as the cathedrals at Chartres, Bruges, Amiens, Reims, and others. Before yielding to Renaissance architecture in the 16th century, Gothic structures had been adorned with thousands of sculptured figures. The rounded arch, of Roman origin, identifies the Romanesque; the pointed arch distinguishes the Gothic.

ARCHITECTURAL CHURCH SCULPTURE, MEDIEVAL AND MODERN



The group of figures at the left has decorated the Royal Portal of Chartres Cathedral since the 12th century. The modern Cathedral of St. John the Divine, in New York City, like the medieval church of France, is decorated with stone carvings (right) which are similar in feeling. Here are four of the nine statues by John Angel in the Martyrs' Portal, west front.

The French cathedral in the town of Chartres, near Paris, is especially rich in fine craftsmanship. The figures in our picture (preceding page) are of the same stone as the columns and are part of them architecturally. Their gestures and expressions, like the simple pattern of their robes, seem frozen and unreal. And yet, in their very columnlike simplicity and rigid stiffness, they fulfill their architectural purpose admirably. Like the saints in the Byzantine paintings and mosaics of this period, their stylized, formal quality was set by tradition and by the church.

The famous Cathedral of Notre Dame in Paris provides us with other important aspects of medieval sculpture—its ingenuity and humor. Early in the Gothic period, sculptors adorned walls and roofs of churches with awe-inspiring monsters, symbolizing the devil's evil ways. Those extending from the wall as spouts for rain water are known as gargoyles; those that simply served to scare men into mending their ways are called chimeras (preceding page). Late Gothic sculptors created many fanciful figures, animal and human, which provided fun in their day.

The most distinguished sculptor carrying on the Gothic tradition in the 20th century is John Angel (born 1881), an Englishman now working in America. His figures for the Cathedral of St. John the Divine, in New York City (preceding page) give material substance to the religious spirit of our day.

The Renaissance in Italy

The term Renaissance, meaning rebirth, is used to describe the vigorous cultural activity of 14th- and 15th-century Italy and the revival of classical learning. Following Italy's lead France and northern Europe too turned their interests from the rewards of heaven to the opportunities of their own world. In doing so they found themselves akin in spirit to the Romans and Greeks before them. In their new love of life and search for knowledge they reached back a thousand years for every shred of instruction and inspiration. The Italians needed only to dig into the ground beneath them to find the splendid sculpture of Rome. It is an error, however, to assume that the artists of that exciting time meant merely to revive the past by imitating its achievements. Theirs was a new day demanding new expression, and they made this period in art the greatest since the Greek.

The first sculptor to strike a new note was Niccolo Pisano (1220?–1284?). His carving on the pulpit in the Baptistery of Pisa resembles the carving on the marble sarcophagi in which the Romans buried their leaders. Niccolo's son Giovanni (1247?–1314?) continued the trend toward greater naturalism and imbued his pupil Andrea Pisano (1270?–1348?) with the same ideal. Andrea brought the new style from Pisa to Florence. His 28 panels on the south doors of the Baptistery in Florence are bronzes of great skill and decorative appeal. They constitute one more important step toward emancipating sculpture from its medieval restraint and formalism.

Two more sets of bronze doors adorn the Baptistery of Florence, both by Lorenzo Ghiberti (*gē-bĕr'tē*) (1378–1455). The first pair, designed for the north entrance, were so successful that he was commissioned to do the east doors as well. For 29 years Ghiberti and his assistants worked to produce the ten panels devoted to Biblical episodes. Finished in 1452 and brilliant in their gilding, the doors still astonish all who see them. Even at the very height of Renaissance artistry in his own day, Michelangelo pronounced them fit to be the "Gates of Paradise." (*See* Ghiberti; for full-page picture, *see* Renaissance.)

DELLA ROBBIA'S SINGING BOYS

Carved for the singing gallery in the cathedral of Florence, these "singing boys," by Luca della Robbia, are now in the museum of the cathedral.

Ghiberti's action-packed, deeply spaced compositions had brought relief sculpture to its highest level. Among the Florentines who could appreciate this fact was Donatello, who was to prove himself the most gifted sculptor of the early Renaissance. Donatello (1386?–1466) shared with artists of his time an eagerness to depict the spirit of adventure and freedom, the same spirit that built new cities, discovered a new continent, and dared to probe the secrets of the universe. His marble statue of Saint George, for example, is sturdy, confident, and just a bit defiant, as befits the youthful champion of Christendom. The bronze 'David' has the easy grace of youth and an elegance comparable to that of Greek sculpture. Donatello's genius for embodying the spirit of the Renaissance is expressed in 'Gattamelata' (page 78*c*).

Erasmo da Narni, nicknamed Gattamelata, was one of those hired soldiers of fortune whom the Italians called *condottieri*. They fought for pay and personal

'LAUGHING BOY'

The marble bust, 'Laughing Boy', by Desiderio da Settignano, Florentine sculptor, has a sweet grace that is very appealing. It is in the National Gallery of Art, in Washington, D. C.

glory and only rarely for an ideal. When Gattamelata died in 1442 the Republic of Venice commissioned a monument to his memory to be erected in his native Padua. Because he was busy with other commissions and because he was undertaking the first equestrian statue since the days of imperial Rome, Donatello took ten years to complete this project.

The horse is almost bursting with the solid power of a modern armored tank and yet is the embodiment of all the gentle grace and rhythmic movement associated with horses on parade. Gattamelata is erect and calm with the untroubled poise of a conqueror. Looking at this magnificent monument one can easily believe that a sculptor can do more to make a general famous than all the general's victories put together.

Donatello's love for the delicate and the cheerful entered into even so formidable a work as 'Gattamelata', where the saddle is decorated with the playful figures of children, known in Italian as "putti." The *cantoria* (singing gallery) in the Florentine Cathedral Museum is one of Donatello's many expressions of his pleasure in depicting children in dance and song.

His younger contemporary, Luca della Robbia (1400?–1482), also made a singing gallery for the same cathedral (preceding page). Luca, his assistants, and his nephew Andrea produced a great deal of sculpture, largely bas-reliefs (low reliefs) (*see* Robbia). They evolved a method of enameling terra cotta with a milky white glaze. This white they applied to figures placed against lovely blue backgrounds. Their many versions of the Madonna and Child are universally admired (for picture, *see* Pottery).

Men of art inspire the art of other men. Teachers pass on to their pupils the fruits of their own hard work. Whether Donatello ever taught Desiderio da Settignano (*sāt-tē-nya'nō*) (1428–1464) is not certain, but this Florentine sculptor learned a great deal from Donatello's work. His 'Laughing Boy', in the National Gallery of Art in Washington, D. C., carries on the tradition of Donatello's graceful naturalism but has its own subtle charm.

Andrea del Verrocchio (*vār-rôk'kyō*) (1435–1488) is the pupil in whom Donatello's genius lives on, just as Verrocchio himself remains a living part of his more famous pupil, Leonardo da Vinci. Although he was distinguished as painter, sculptor, silversmith, and architect, Verrocchio's fame rests largely on his equestrian statue of Colleoni (next page).

Colleoni, another Venetian general, died 32 years after Gattamelata. In his helmet and coat of mail, with head and body turned at angles, the general thrusts his outstretched legs into the stirrups. There are a dash and daring and even a note of arrogance in the posture. The powerful stallion seems every bit as proud as its master and looks resplendent in its ornamental trappings and curly mane. There are majesty and vitality in every muscle of its forward stride

It is important to note that both the 'Gattamelata' and the 'Colleoni' were commissioned by the republic of Venice and not by the church. The church continued to call upon the artist, as it had done for a thousand years, but it was no longer his sole patron.

MICHELANGELO'S 'BOUND SLAVE'

This statue, now in the Louvre, Paris, was designed for the tomb of Pope Julius II. It illustrates Michelangelo's unrivaled ability to endow a block of marble with great strength and energy.

Families of merchant bankers had grown up with wealth and power enough virtually to control the city-states. The Medici family, for example, held sway over the city of Florence, and its patronage was eagerly sought by all artists. These families required the services of art to glorify their deeds and to enhance their social prestige.

Michelangelo, Greatest Sculptor of Modern World

Lorenzo de' Medici (Lorenzo the Magnificent) delighted in the company of artists as well as in his rich collection of ancient manuscripts and antique sculpture. Ancient marbles, recently dug up, were placed in his gardens to be admired and to serve as inspiration for aspiring young talents. To these gardens and to the household of Lorenzo came a boy named Michelangelo Buonarroti (1475–1564), destined to create the most dynamic, robust sculpture in the modern world.

By the age of 26 he was carving the heroic marble 'David', a triumph of anatomical knowledge. His Medici tombs, in the Chapel of San Lorenzo, Florence, are masterpieces of mortuary sculpture. Probably his greatest works are the 'Bound Slave' (preceding page) and 'Moses' designed for the tomb of Pope Julius II.

The marble 'Moses' is justly regarded as the supreme example of skill and characterization. Troubled and disillusioned in his own long life, Michelangelo knew well how to carve into the face of Moses that look of sternness, sorrow, and amazement. What the great lawgiver beheld among the Israelites on his descent from Mount Sinai is dramatically expressed not only in the face but in every agitated rhythm that courses through the beard, the limbs, and the drapery. (For picture, *see* Michelangelo.)

Michelangelo's achievements as a painter in the Sistine Chapel and as an architect for St. Peter's Church in Rome were enough to give him world-wide fame, but he preferred to sign himself "Michelangelo, Sculptor." As a sculptor he dominated the golden age of the Italian Renaissance and his tremendous influence on sculpture has continued to our own day.

The brilliance of the Renaissance in Italy was meanwhile spreading through Europe, and monarchs competed for the services of Italian artists and craftsmen.

Cellini and Da Bologna

Benvenuto Cellini (*chĕ-lē'nē*) (1500–1571) went to France at the invitation of Francis I. The exquisitely wrought saltcellar which he made for this royal patron reveals his talents as a goldsmith (for picture, *see* Metal Working). Large-scale sculpture he undertook later in his career, distinguishing himself with the bronze 'Perseus', which he made on his return to Florence. Cellini's description of the modeling and casting of this statue in his famous 'Autobiography' is in itself a masterpiece.

While some Italian artists journeyed to other lands, eager northerners came to Italy to study the new developments at their source. From Flanders came a young man who was to fall under the spell of Michelangelo and give the Renaissance in Italy its last great note of triumph. Arriving in Florence in 1553, he remained in Italy to become known as Giovanni da Bologna, or Giambologna (1524–1608). The 'Flying Mercury' is an extraordinary bronze of a figure in flight. His 'Neptune Fountain', at Bologna, is a work of vivid imagination and technical supremacy. Giovanni da Bologna concludes the great chapter of Italian sculpture of the Renaissance, but he also stands as a link between the Renaissance and the period described as the *baroque*. In him the graceful elegance of the earlier Italian masters is secondary to the qualities

EQUESTRIAN SCULPTURE OF THE RENAISSANCE

Donatello's equestrian statue (left) of the Italian soldier of fortune Gattamelata stands in the city of Padua. Man and horse are bursting with power, yet they are graceful and rhythmical. The Colleoni statue by Verrocchio (right), in Venice, is remarkable for its bold, aggressive energy. These are perhaps the world's finest examples of equestrian statues.

ITALIAN AND FRENCH BAROQUE

Sculpture in the baroque style frequently attempted to do theatrical things. Its exaggerations are apparent in Bernini's 'St. Teresa' (left), in the church of Santa Maria della Vittoria, Rome.

Houdon's marble bust of Benjamin Franklin (right) is in the Metropolitan Museum of Art, New York City. Houdon, a gifted portraitist, modeled many American and French notables.

characteristic of Michelangelo's followers: dramatic movement, exaggerated gesture, and technical skill.

The Baroque in Sculpture

Michelangelo had shown the way to express robust power with technical excellence. In his day these attributes of art were urgently desired by both church and state—the church to bolster its prestige in the face of Protestant successes, and the state to glorify its rising power. This trend carried over into the 17th century, when the zeal that built St. Peter's in Rome expressed itself in a renewed vigor wherever Roman Catholicism prevailed. Meanwhile the courts of Europe, especially in France and Germany, reveled in a flamboyant magnificence.

The leader of the baroque movement was Giovanni Lorenzo Bernini (1598–1680), architect as well as sculptor. The series of 162 figures which surmount his imposing colonnade in front of St. Peter's in Rome are only a part of the tremendous amount of work he did for the church. His fountains of Rome, such as the 'Fountain of the Four Rivers', gave the Eternal City a new and lasting splendor. Typical of Bernini's style is his 'St. Teresa', where the overactive drapery and theatrical setting are designed to show off skill rather than to convey meaning.

Sculpture in France

The Renaissance in France began about the time of Francis I (1494–1547) To his court were invited many Italian artists and architects, among them Benvenuto Cellini and Leonardo da Vinci. A little later, as the power of Italy waned and that of France rose, the ideas transplanted to the new country took deep root and blossomed into new life.

Even as early as the 15th century Michel Colombe (*kō-lŏm'*) (1430?–1512?) had enlivened the old Gothic form with a touch of the new realism. But it was Jean Goujon (*gō-zhôn'*) (1515?–1566?) in the 16th century who first achieved great distinction as a sculptor. With him the Renaissance in France came into full swing. His sculptured reliefs of nymphs decorating the 'Fountain of the Nymphs' (next page) are outstanding.

In the 17th century France responded to the influence of Bernini and the baroque. The sculpture of Pierre Puget (*pu-zhĕ'*) (1622–1694) shows the exaggerations of the Bernini manner. François Girardon (*zhē-rär-dôn'*) (1628–1715) worked under Puget for a time, and toward the end of the century became the leading sculptor in France. By the 18th century, French taste and skill had become the envy of Europe. The court at Versailles sparkled in regal elegance; and sculptors, along with painters and architects, were glorifying the gay, the gracious, and the frivolous.

Sharing in this atmosphere of elegance, but free from frivolity, was Jean Antoine Houdon (*o-dôn'*) (1741–1828). Particularly successful as a portraitist, he worked in Rome, in the court of Frederick the Great of Prussia, and in America, as well as in his native France. His portrait busts show a searching study of character rather than a preoccupation with superficial charm so characteristic of his time.

While Benjamin Franklin was abroad courting the help of the sympathetic French, he sat for the portrait by which he is known to many Americans. So pleased was the American patriot with Houdon's interpretation that when Congress sought a sculptor for a full-length figure of George Washington, Franklin per-

'APE RIDING A GNU', BY BARYE

This statuette is rich in the active rhythms, muscular vigor, and loose, broad modeling that make Barye's small bronzes the finest of their kind. This cast is in the collection of the Corcoran Gallery of Art, Washington. D. C.

suaded Houdon to cross the ocean. One of his bronze figures of Washington now stands in the Capitol of Richmond, Va. Another is at Mount Vernon (for picture, *see* Washington, George).

Neoclassicism in Sculpture

For all the interest in classical antiquity during and after the Renaissance there had been no systematic study of classical remains until the brilliant and inspired work of the German archaeologist Johann Joachim Winckelmann (1717–1768). His published writings on Herculaneum and Pompeii led to a new, impassioned interest in the ancient art of Greece and Rome. Artists now resolved to revive classical purity by adhering strictly to the style of original examples.

This movement, known as neoclassicism, began in the latter half of the 18th century and continued into the early 19th, when it gained political support through Napoleon's interest in Greek ideology. The leading exponent of this style in Italy was Antonio Canova (1757–1822). However correct in principle, his work remains cold in feeling, just as were the works of his followers in England, Germany, and Denmark.

In England John Flaxman (1755–1826) applied new classicism to public monuments and to the designing of classic motifs for Wedgwood chinaware. Germany's outstanding sculptors in this widespread tradition were Johann Gottfried Schadow (1764–1850) and Johann Heinrich von Dannecker (1758–1841). Bertel Thorvaldsen (1770–1844) of Denmark worked in Italy for about 40 years and won admiration for his rhythmic and rather chilly variations on the ancients' themes. (*See* Thorvaldsen.)

The 19th Century

The formality and coldness of neoclassicism came as a reaction against the theatrical baroque and against the florid *rococo*, which flourished in 18th-century France. Moreover, the political atmosphere in which the new art operated was sympathetic to the reverence for the ancients. Napoleon saw himself as another Caesar. His minister of art, Jacques Louis David, caused even furniture and dress to be designed in classical lines. Gradually, however, artists were turning to the greatest source of inspiration, the life about them. François Rude (1784–1855), a classicist by training, broke through classical restraint to create one of the world's most stirring relief compositions—the 'Marseillaise' on the Arc de Triomphe, in Paris. Rude's pupil Jean Baptiste Carpeaux (*kår-pō'*) (1827–1875) carried on the active, emotional themes.

Antoine Louis Barye (*bȧ-rē'*) (1796–1875) meanwhile was producing a series of bronzes showing

A MASTERPIECE OF THE FRENCH RENAISSANCE

The greatest sculptor of the French Renaissance was Jean Goujon. Figures from his 'Fountain of the Nymphs' are in the Louvre, Paris. One, the reclining nymph, personifying the River Seine, is set against a background of mythological symbols.

'ABRAHAM LINCOLN', BY SAINT-GAUDENS

This bronze statue in Lincoln Park, Chicago, Ill., done by an American sculptor, shows a man dignified, yet humble, tense with troubles of state, but eased by a clear and resolute conscience.

animals in dramatic, sometimes violent, action. The intensity and accuracy of his observations and his vigorous interpretation of nature are a contrast to the soft, studied mannerisms of the neoclassicists. Like many of Barye's works, the 'Ape Riding a Gnu' (preceding page) dramatizes a struggle between two animals; unlike the savage struggles of his jungle beasts, these two show more fun than fury.

Barye used as his models the animals in the Paris zoo, but his inspiration came from the age in which he lived. Europe had known revolution and disillusionment. It was now feeling a sense of personal dislocation and deprivation brought about by the Industrial Revolution. Love of personal liberty and of national independence, romance, and adventure sought expression in the arts. Into this vigorous *romantic* period, Auguste Rodin (1840–1917) was born. We have already discussed his 'Burghers of Calais'. We need only add that Rodin's sculpture embraces the full range of feeling which characterized his time. (*See* Rodin.)

Among the students of Rodin who gained distinction in France was Émile Antoine Bourdelle (1861–1929). Constantin Meunier (*Mû-nyā'*) (1831–1905) proved himself the outstanding Belgian sculptor of the 19th century. His monuments are sympathetic tributes to the dignity of labor.

Two outstanding representatives of the period in England were Alfred Stevens (1817–1875) and Frederick, Lord Leighton (1830–1896). In Germany too the basic adherence to classical themes and style became modified by a closer study of nature and by the greater freedom in outlook of the romanticists. Max Klinger (1857–1920) and Adolf von Hildebrand (1847–1921) produced some noteworthy sculpture.

Sculpture in the United States

The American colonists had cut themselves off from the main sources of culture in their home countries. Years were to elapse before a Benjamin West in painting or a William Rush in sculpture were to emerge on the new soil. Meanwhile they produced their own kind of art objects. Their achievements were humble and their quality often naïve, but there were directness and sincerity in their products as well as a great deal of natural, unaffected charm. Many homes and museums have preserved these early efforts, to find that they are treasured now as works of art.

The first individual sculptor of importance in this country was the Philadelphian William Rush (1756–1833), who worked in wood. He left a fine full-length carving of George Washington. His younger contemporaries, however, were studiously copying European examples of the neoclassic school in Italy. Horatio Greenough (1805–1852) made an imposing figure of George Washington in which the first president looks more like a half-dressed Roman emperor than the "father" of his rugged country. Thomas Crawford (1813?–1857) decorated the Capitol in Washington. The statue of 'Armed Liberty' surmounting the dome and the bronze doors are among his best works.

Henry Kirke Brown (1814–1886) broke away from the sweet and sentimental in his robust and monumental equestrian statue of George Washington in Union Square, New York City. John Quincy Adams Ward (1830–1910) carried American independence in sculpture even further. His standing figure of Washington in front of New York City's Sub-Treasury Building, on Wall Street, is dignified and monumental without remotely resembling a Greek god or a Roman emperor.

In Augustus Saint-Gaudens (1848–1907) American sculpture reached a stature compatible with its own growing wealth and prestige among nations (*see* Saint-

A RIVER SYMBOLIZED IN HUMAN FORM

Maillol's 'The River' is here displayed in the garden of the Museum of Modern Art, New York City. It is a lead cast, 7½ feet long. His work is notable for classic repose and serenity.

Gaudens). At a time when monuments to Civil War heroes were being put up with much more sentiment than sensitivity, Saint-Gaudens broke away from classical tradition and produced realistic works of great power.

Several other Americans came back from their studies abroad to establish sculpture on a high plane at home. Daniel Chester French (1850–1931) is well known for his figure of Lincoln in the Lincoln Memorial, Washington, D. C. (*see* French; for picture of Lincoln statue, *see* Lincoln, Abraham). Frederick MacMonnies (1863–1937), who studied in Paris and with Saint-Gaudens, is known for 'Nathan Hale' (for picture, *see* Hale, Nathan) and the 'Horse Tamers', in Brooklyn's Prospect Park. George Grey Barnard (1863–1938) had his early training in the French romantic-impressionistic school of Rodin but developed an individual power and imagination in works such as 'Two Natures', in the Metropolitan Museum of Art, New York City.

In the meantime a small group of Americans were interpreting animal life and Indian lore. Paul Wayland Bartlett (1865–1925) is best known for 'The Bohemian Bear Tamer', in the Metropolitan Museum of Art, New York City. With Frederic Remington (1861–1909), cowboys and Indians and their horses became the models for some exciting bronzes. Gutzon Borglum (1867–1941), whose Mount Rushmore National Memorial we saw on page 73, also produced a number of vigorous portraits, including the colossal head of Lincoln in the rotunda of the Capitol in Washington.

The 20th Century

Sculpture in the 20th century is a record of this century—its doubts, diversities, and incredible achievements. It is a brilliant, if somewhat bewildering, record and cannot be comprehended except by open-minded study.

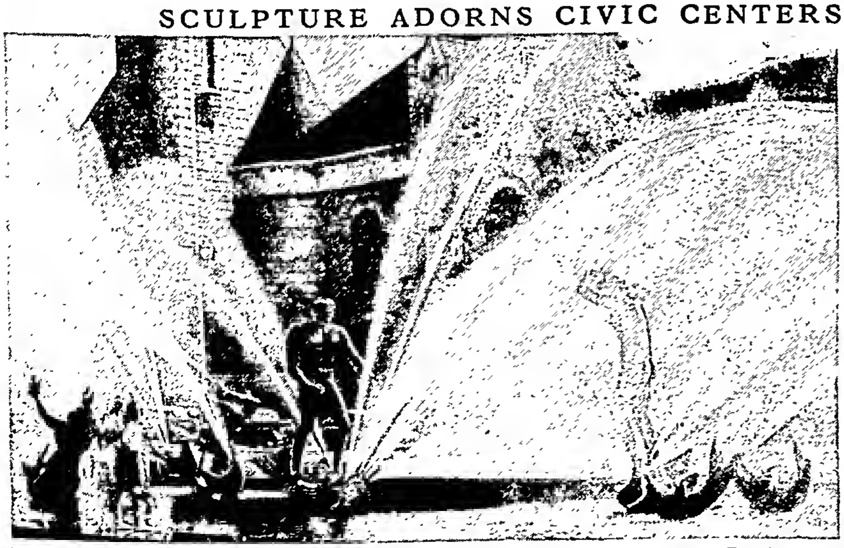
We have seen that the road to modern sculpture was cleared by Rodin's freer handling of material and bolder expression of feeling. It was Rodin too who remarked on the basic problem of all sculpture, regardless of materials used or feelings conveyed. "Sculpture," he said, is "the art of the hole and the lump"; that is, the art of mass and space. The story of sculpture after Rodin ranges from the expression of feelings which he helped liberate to the carefully contrived "lumps and holes" which are the basis for certain extreme forms of modernism.

Rodin's influence extended far beyond his gifted studio assistants such as Émile Antoine Bourdelle, Charles Despiau (*dĕs-pē-ō′*) (1874-1946), or the dynamic Yugoslav Ivan Mestrovic (*mĕsh′trō-vĭch*) (born 1883). Even painter-sculptors such as Renoir, Degas, Matisse, and Picasso show evidence of their debt to him. Among those who carried the Rodin tradition to a high level is Jacob Epstein, whose 'Madonna and Child' we have discussed (*see* Epstein).

Aristide Maillol (*mȧ-yôl′*) (1861-1944), a French painter who turned sculptor in his 40's, reintroduced a classic grace and calm, concentrating on the female form. 'The River' (preceding page) is one of his last works and typifies his ability to convey the sense of living flesh in beautiful rhythms. A student of both Rodin and Maillol was Germany's most expressive sculptor, Wilhelm Lehmbruck (1881-1919). His 'Kneeling Woman', in the Museum of Modern Art, New York City, is extraordinary in its graceful elongation and touching melancholy. Gaston Lachaise (*lȧ-shĕz′*) (1882-1935) was born in Paris and came to the United States in 1906. Here he developed the style exemplified in the 'Standing Woman', a sleekly surfaced, voluptuous nude of overpowering effect.

The tendency of all these men to idealize form comes as a reaction to naturalism in the arts and to Rodin's impressionism. Carl Milles (born 1875), for example, has carried on the tradition of 17th- and 18th-century fountain sculpture. His 'Orpheus Fountain', in his native Stockholm, and the fountain, 'Meeting of the Waters' in St. Louis, Mo., are among his best. The St. Louis fountain is composed of 19 figures, two of

SCULPTURE ADORNS CIVIC CENTERS AND GARDENS



This fountain by Carl Milles, called the 'Meeting of the Waters' (left), stands in St. Louis, Mo., in the plaza facing the Union Station. The 'Diana' (right), by Paul Manship is in the Brookgreen Gardens near Myrtle Beach, S. C. The gardens are an open-air museum "for the preservation of the flora and fauna of the Southeast and to exhibit objects of art."

which symbolize the joining of the Mississippi and the Missouri rivers north of the city.

Paul Manship (born 1885) uses classical antiquity as a basis for a highly decorative elegance, as expressed in 'Diana' (preceding page). Huntress and hound have poise and power, their bodies sharing in that stylized grandeur of Manship's sculpture at its best. Among his works is the 'Prometheus' fountain in Rockefellei Center, New York City. Many others, such as William Zorach (born 1887), are working along the same lines, each varying the forms according to his purpose.

Daring Departures from Tradition

We come now, however, to a group of sculptors for whom nature serves as a point of more daring departure. The leader of this development is Rumanian-born Constantin Brancusi (born 1876), who pioneered in the use of abstract forms. One would never suspect from his propellerlike 'Bird in Flight' or his variations on the egg shape, such as 'Mlle Pogany', that his earliest work is strongly influenced by Rodin.

We have already discussed in an earlier connection two very important artists of this period—Amedeo Modigliani and Henry Moore. Both were influenced by Brancusi. An American who came under the same influence was John B. Flannagan (1895-1942). His field stone 'Frog' is one of the most charming things that ever happened in stone. This is no ordinary amphibian, but a gentle, slightly philosophic creature determined to say less than he knows.

Another trend in 20th-century sculpture had its origin in the cubist and futurist movements and was closely associated with experiments in painting. As early as 1909 Pablo Picasso (born 1881) had made

THE 'FROG', BY JOHN B. FLANNAGAN

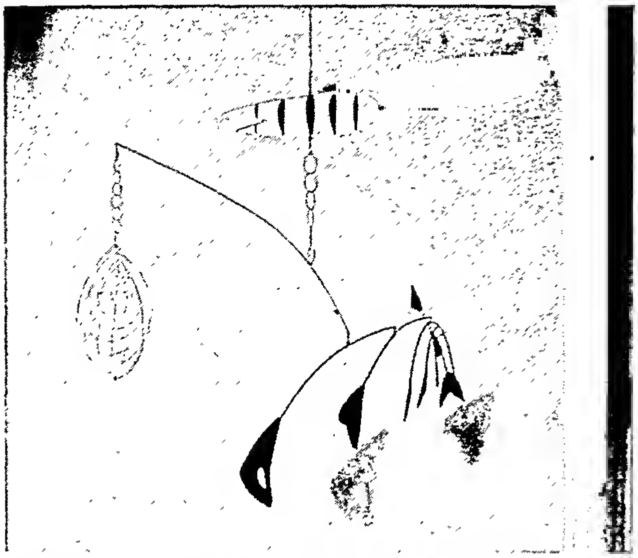
This delightful little frog was carved directly out of field stone Like archaic sculpture, it preserves the identity of the original rock. It is owned by the Detroit Institute of Arts.

'Head of Woman' (Museum of Modern Art, New York City), reducing volumes to geometric planes intersecting at sharply defined angles. Based on the painter Cézanne's use of broad color planes, this technique, called cubism, set in motion a wholly new kind of thinking. Among those who followed Picasso's lead were Jacques Lipchitz, Henri Laurens, Alexander Archipenko, Ossip Zadkine, and the small group of men associated with the related movement, *futurism* Futurism, born in Italy about 1911, is an attempt to convey a sense of movement of an object through

TWO MODERN ABSTRACTIONS IN BRONZE AND MARBLE

The bronze 'Horse' (left), by Raymond Duchamp-Villon (Museum of Modern Art, New York City), suggests the coiled-up power of the animal, about to move through space. The marble 'Mlle Pogany' (right), by Constantin Brancusi (Philadelphia Museum of Art), seems to be based on the smooth and subtle curvature of the egg. The features have an egglike fragility.

'LOBSTER TRAP AND FISH TAIL'



Steel wire and sheet aluminum acquire graceful shapes in this mobile by Calder (Museum of Modern Art, New York City). Delicately balanced, it changes character with every gentle breeze.

space. Its chief exponents were Umberto Boccioni (*bōt-chō'-nē*) (1882-1916), in Italy, and Raymond Duchamp-Villon (*dü-shôṅ'-vē-yôṅ'*) (1876-1918), in France. Boccioni is best known for 'Unique Forms of Continuity in Space', and Raymond Duchamp-Villon for his intriguing 'Horse' (preceding page). Among the early cubists was Jacques Lipchitz (born 1891), who has more recently turned to rounded, massive forms depicting symbolic themes in strikingly imaginative terms.

The cubists' emphasis on geometric pattern to the relative exclusion of recognizable subject matter induced some sculptors to travel far down that road. The American Alexander Calder (born 1898) uses delicately balanced shapes and colors in subtle, unusual arrangements. They are made of wire, aluminum, and many other materials. Because these are capable of movement they are called *mobiles;* those which do not have movable parts are called *stabiles.*

'PROMETHEUS STRANGLING THE VULTURE'

This bronze by Jacques Lipchitz (Philadelphia Museum of Art), gives a fresh, modern interpretation to an old story. Here it is Prometheus and not the vulture who is triumphant.

There is a group of sculptors who regard cubism and all its derivations as rather superficial. Their own interests are in delving beneath the surface of personality to where the deepest feelings lie. There, in the realm of the subconscious, they find the inspiration for their surrealistic expressions. Julio Gonzalez (1876-1942) and Alberto Giacometti (born 1901) are representatives of this school of sculpture, as Miró and Dali are of surrealist painting (*see* Painting).

Sculpture in the Orient

Reports of the splendor of Oriental art were brought to Europe by Marco Polo. By the 18th century, Europeans not only possessed original ceramics, enamels, and furniture from the East but were adapting Oriental designs and skills to their own needs. Chinese Chippendale furniture and chinaware are examples. The art of Japan was brought into prominence about a hundred years ago in Paris by the De Goncourt brothers, and it was Rodin who first gave public recognition to the sculpture of India. In the latter part of the 19th century when artists were seeking inspiration for a newer, fresher art, these sources, together with those of Africa and the Mohammedan countries, provided them with rich material.

Sculpture in India was centered around the worship of Buddha and the three gods who form the trinity of Brahmanism—Brahma (the Creator), Vishnu (the Preserver), and Siva (the Destroyer). Although Gautama Buddha lived in the 6th century B.C., it was not until the 1st century A.D. that the familiar statues of him appeared. The Gupta period, lasting from the 4th to the 6th century A.D., produced some of the finest examples of Buddhistic sculpture. For the first 700 years of the Christian Era, the Ghandara region, now in modern Afghanistan, produced many beautiful examples of Greco-Buddhistic sculpture. The Hellenistic influence was introduced following the conquest of north India by Alexander the Great. (For picture of a Ghandara head, *see* Buddha.)

The Brahman god Siva is more than the Destroyer. He is also god of the arts, especially of dancing. As a cosmic dancer he is depicted in a superbly graceful and decorative bronze, cast sometime between the 13th and 14th centuries. (For picture, *see* India.) To Siva also are dedicated the monumental rock-hewn temples of the period from the 5th to the 8th century. The equally majestic sun temples to Vishnu date from the 11th to the 13th century.

The Chinese were master craftsmen and produced some of the finest sculpture in the world, especially in bronze. Although bronze casting existed a thousand years earlier, it was in the Chou period (about 1100-250 B.C.) that China developed the art to a degree that has never been surpassed. This is evident in the

great ceremonial vessels used by the nobility for ancestor worship. From tombs of the Han Dynasty (206 B.C.-A.D. 220) have come a rich variety of clay figures of people, animals, and household utensils designed to make life comfortable in the next world. Other objects are wrought in bronze, inlaid with silver and gold, and elaborately ornamented with abstract and fanciful designs. Carvings in jade and bas-reliefs on tomb walls also reached a high degree of excellence.

In the 5th century Buddhism began to spread through China, bringing a powerful religious stimulus to sculpture. The prosperous T'ang Dynasty (618-907) developed Buddhistic art to its highest level. Stone had by now become a favorite medium for religious sculpture, and iron replaced bronze in the casting of figures. The glazed terra-cotta figures of this period are also among the finest ever produced.

With the decline of Buddhism in the Sung period (960-1279) sculpture lost its vigor and was never to regain it, even though painting, architecture, and pottery making flourished for several more centuries. Nevertheless a great number of interesting works continued to be produced. From the 12th century comes the lovely Bodhisattva shown on page 72 in this article. Bodhisattvas were followers of Buddha who aspired to his state of enlightenment. In Japan, Buddhism and its art followed the Chinese pattern with little variation.

Sculpture in Education

In the education of people of all ages sculpture plays a vital role. As a record of man's experience in all lands and in every age, it provides us with the knowledge and insight necessary to an understanding of our world. As the language of gifted artists, sculpture speaks to us with an order, eloquence, and beauty which stir our own efforts toward deeper insight and richer expression.

In any real program of education the appreciation of sculpture goes hand in hand with one's own expression through sculpture. More and more people are realizing that all the arts are means by which we express and share our experiences with others; that in this expression and sharing we grow steadily richer in the knowledge of ourselves.

WORK OF A HIGH-SCHOOL SCULPTOR

This highly imaginative ceramic animal is the work of a Chicago high-school student. Sculpture as a form of expression for young and old leads to a deeper insight into life.

We know today that sculpture, like other arts, is not for the highly talented only. Sculpture does not require that we be like Michelangelo, Rodin, or Alexander Calder. We need only be ourselves. Thousands of art classes throughout the country prove that young and old find tremendous satisfaction in creating their own three-dimensional worlds through an endless variety of media. A lump of clay, a block of marble, a cake of soap, or even a piece of wire can take on life and meaning by an effort that is sincere and an expression that is truly personal. The difference between one person and another may not be great, yet it represents individuality and should be encouraged to find expression and growth. (*See also* Arts, The.)

Sculpture teaches us how, in the course of his adjustment and survival, man learned to use the clay in the earth and the sticks and stones of his environment to shape his ideas and to serve his needs. Today, where education is at its best, boys and girls and men and women are free to shape their own ideas and to serve their own needs through organizing an infinite variety of materials into the tangible form we call sculpture. Sculpture is everybody's pleasure, just as surely as self-expression is everybody's need.

REFERENCE-OUTLINE FOR STUDY OF SCULPTURE

SCULPTURE IS A RECORD OF HUMAN EXPERIENCE (S-70, 72)

I. **The scope of sculpture** S-70, 72, pictures S-73, 75

II. **Tradition in sculpture** S-72-3, pictures S-73, 75

III. **Relation to other arts** A-400*a-p*: painting P-21-38; pottery P-393-401

IV. **Sculpture in the schools** S-84, pictures S-84, A-400*o*

HOW SCULPTORS WORK (S-70-5)

I. **Organization and form** S-70, A-400*h-i*

II. **Materials and processes** S-74-5: suiting design to materials A-400*g*, pictures A-400*i*

III. **Lighting and point of view** S-74, pictures S-74

SCULPTURE THROUGH THE AGES

I. **Primitive** S-75-6, color picture S-72, pictures S-75, 76, A-543, I-108*e*, 109, 110, M-143*b*, M-205, N-228*a*, P-2, R-257

II. **Ancient Egypt** S-76, E-285, color pictures S-72, A-307, pictures S-73, E-278*b*, 280, 283, 285, S-338, W-190

III. **Mesopotamia** S-76, B-6, pictures S-75, A-298, B-5, 7, 8, 9

IV. **Persia**, pictures P-157

V. **Aegean region** A-29, picture A-28: Hittites, H-385-6

VI. Ancient Greece S-77, G-203-6
   A. Archaic period S-77, G-203, picture G-204
   B. Attic period A10-12, A-448-9
      1. Myron G-204 ('Discus Thrower' E-444)
      2. Polyclitus G-204, H-341
      3. Phidias and his disciples P-187-8: the Parthenon A-12, color picture A-307, pictures A-11, G-200, 206; statue of Olympian Zeus Z-351, S-105, picture S-106; 'Venus de Milo' probably of Phidias' school G-204, A-273
      4. Praxiteles G-204-6: Hermes, picture S-77
      5. Scopas and Lysippus G-206: Ares, picture G-204
   C. Late Greek period G-206: 'Apollo Belvedere' A-274; 'Winged Victory of Samothrace', picture S-77

VII. Ancient Rome G-206-7, S-77-8, pictures G-206, 207, R-183

VIII. The Middle Ages (Romanesque and Gothic) S-78-78*a*. For ornamentation of the great cathedrals, see the Reference-Outline for Architecture

IX. The Renaissance S-78*a*-*c*, R-104-6
   A. Beginnings of the Renaissance in Italy
      1. Niccolo, Giovanni, and Andrea Pisano S-78*a*: pulpit, picture E-442
      2. Giotto G-111-12
      3. Ghiberti G-107: doors, picture R-105
      4. Donatello S-78*a*: statue of Gattamelata, picture S-78*c*; 'Saint Peter' P-165
      5. Luca della Robbia S-78*b*, R-162: 'Singing Boys' S-78*a*; 'Madonna' P-400
      6. Verrocchio S-78*b*: statue of Colleoni, picture S-78*c*
   B. Full flowering of the Renaissance in Italy
      1. Michelangelo M-212-14, S-78*c*: 'Moses' M-212; 'Madonna della Pietà' M-213; 'Dawn and Dusk' and 'Virgin and Child' M-214; 'Bound Slave', picture S-78*b*
      2. Cellini S-78*c*: salt cellar, picture M-178
      3. Da Bologna S-78*c*
   C. The Renaissance in Europe S-78*d*: Goujon S-78*d*; 'Fountain of the Nymphs', picture S-79

X. Baroque and Rococo styles S-78*c*-*d*
   A. Italy: Bernini S-78*d* ('St. Teresa' S-78*d*)
   B. France: Houdon S-78*d*, bust of Franklin, picture S-78*d*; bust of Washington, picture W-19

XI. Neoclassicism S-78*d*-79: Thorvaldsen T-122-3, S-79

XII. Romanticism S-79-80
   A. Barye S-79-80: 'Ape Riding a Gnu', picture S-79
   B. Bartholdi B-61: 'Lion of Belfort', picture B-61; 'Liberty Enlightening the World', picture L-179

Note: See also in Fact-Index Barrias, Louis Ernest; Canova, Antonio; Carpeaux, Jean Baptiste; Colombe, Michel; Dannecker, Johann; Flaxman, John; Girardon, François; Hildebrand, Adolf von; Klinger, Max; Leighton, Lord Frederick; Meunier, Constantin; Puget, Pierre; Rude, François; Schadow, Johann Gottfried; Stevens, Alfred; Watts, George Frederick; Winckelmann, Johann Joachim

SCULPTURE IN THE UNITED STATES (S-80-3)

I. Early 19th century: Rush, Greenough, Crawford, Brown, Ward S-80

II. Saint-Gaudens S-80-1, S-17-8: 'Lincoln', picture S-80, 'Adams Memorial', picture S-17

III. French F-284-5, S-81: Lincoln Memorial, picture L-251; Gallaudet statue, picture F-285

IV. MacMonnies S-81: 'Nathan Hale', picture H-247

V. Borglum B-253: Mount Rushmore Memorial, picture S-73

VI. Hancock: 'Robert Frost', pictures S-74

VII. Manship S-82: 'Diana', picture S-81

VIII. Zorach S-81: 'Child with Cat', picture A-400*i*

IX. Calder S-83: mobile, picture S-83

X. Flannagan S-82: 'Frog', picture S-82

Note: See also in Fact-Index Barnard, George Grey; Bartlett, Paul Wayland; Dallin, Cyrus Edwin; Davidson, Jo; Grafly, Charles; Hoffman, Malvina; Polasek, Albin; Remington, Frederic; Warneke, Heinz

MODERN EUROPEAN SCULPTORS (S-81-3)

I. Rodin S-80, 81, R-176-8: 'Burghers of Calais' S-70, color pictures S-71; 'Thought', 'Adam', 'Eve', 'The Thinker', pictures R-177

II. Epstein S-81, E-390: 'Madonna and Child' S-73; 'Mexican Girl' E-390

III. Maillol S-81: 'The River', picture S-80

IV. Milles S-81: 'Meeting of the Waters' fountain, picture S-81; 'The Rocks' D-55

V. Brancusi S-82: 'Mlle Pogany', picture S-82

VI. Modigliani S-75: stone head, picture S-75

VII. Picasso S-82

VIII. Boccioni S-82

IX. Duchamp-Villon S-83: 'Horse', picture S-82

X. Lipchitz S-82: 'Prometheus Strangling the Vulture', picture S-83

XI. Henry Moore S-73-4: 'Madonna and Child', picture S-73; 'Family Group', picture A-400*i*

XII. John Angel S-78*a*: sculpture for Cathedral of St. John the Divine, picture S-78

Note: See also in Fact-Index Archipenko, Alexander; Arp, Hans; Bourdelle, Émile A.; Despiau, Charles; Giacometti, Albert; Gonzalez, Julio; Lachaise, Gaston; Laurens, Henri; Lehmbruck, William; Mestrovic, Ivan; Pevsner, Antoine; Zadkine, Ossip

SCULPTURE IN THE ORIENT (S-83-4)

I. China S-83-4, C-279: enameled figure, picture E-342; statue of Bodhisattva, color picture S-72

II. Japan J-314

III. India S-83, I-65: god Siva, picture S-66; carved pillars of Hindu temple, picture S-66; Ghandara head of Buddha, picture B-339

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SCUP. One of the common shore fishes of the eastern United States, the scup is a popular food fish, marketed principally along the Atlantic coast.

The fish is brown, tinged with red or pink above, paling on the sides to silvery under parts. It reaches a length of 18 inches and a weight of three to four pounds, but 12-inch fish weighing one and a half to two pounds are average size. Scup live on smooth, hard sand bottoms, feeding on shellfish, worms, and small fish. They are taken in Chesapeake Bay from April to October. In the winter they migrate to deeper waters off the Virginia coast.

Scup belong to the porgy family (*Sparidae*). The scientific name is *Stenotomus chrysops*.

SEA ANEMONE. In tidal pools on rocky shores live beautiful flowerlike animals, the sea anemones. When the tide is out they look like sodden lumps of jelly; but as the water flows over them they expand into strange and lovely forms. Many kinds are found on both coasts of North America, but those in tropical waters are the most brilliantly colored.

The soft body is column shaped, about as broad as it is high. The spreading base is usually attached by a slimy, suckerlike disk to a rock or to the piles of wharves. The animal also glides about very slowly on this disk. The upper end of the column expands into the mouth opening, which is surrounded by several circles of hollow tentacles. They vary in number but are usually some multiple of six. In each tentacle are thousands of threadlike tubes, each one armed with a poisoned barb. When a shrimp or small fish touches a tentacle it is pierced and paralyzed by these barbs. A set of tiny threads (flagella) in the gullet beat downward, drawing a current of water into the body and providing it with oxygen. A second set beat upward, creating an outgoing current and discharging carbon dioxide and other wastes. When a victim is caught by the tentacles these threads reverse their course and draw the food into the body cavity.

Anemones reproduce by pulling apart into two halves (fission), by budding from the base, or by eggs. Eggs and sperms form on the partitions of the body cavity and are ejected through the mouth. The fertilized egg develops into a free-swimming larva, which grows into an anemone. Sometimes an injured piece of the body is left behind as the animal moves about. This damaged section regenerates into a tiny anemone.

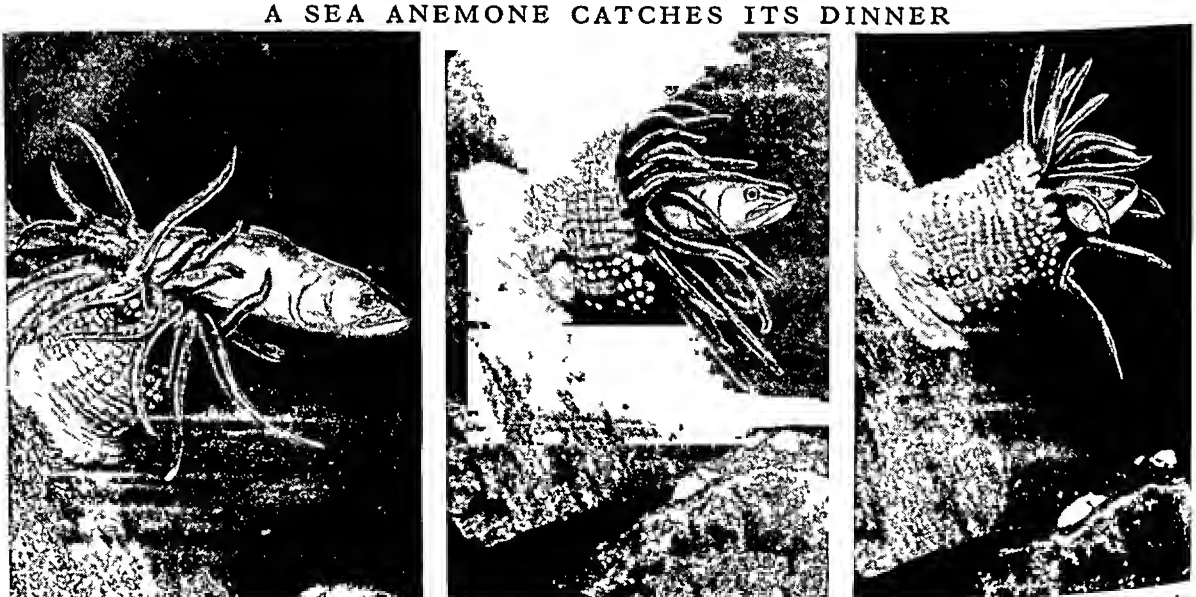
Sea anemones are polyps of the phylum *Coelenterata*, which also includes the jellyfish. Together with coral the anemones belong to the class *Anthozoa*, meaning "flower animals." There are about a thousand species in all the oceans of the world. (*See* Coral.)

SEA CUCUMBER. The sea cucumber is a primitive, undersea animal that resembles a garden cucumber or a large caterpillar. It occurs in most seas and at all depths. Some species move over the bottom, some live among rocks, coral, or seaweeds, while still others bury themselves in sand or mud.

The sea cucumber belongs to the *Echinoderms*, a group which also includes the sea urchin and starfish (*see* Starfish and Sea Urchins). Unlike them it has a long, wormlike body, and the spines, which characterize the group, are reduced to minute scales embedded in the tough, leathery body. It attaches itself to rocks by means of rows of tubular feet, but it creeps about with muscular movements of the body. Finely branched tentacles around the mouth are slimy and catch small animals.

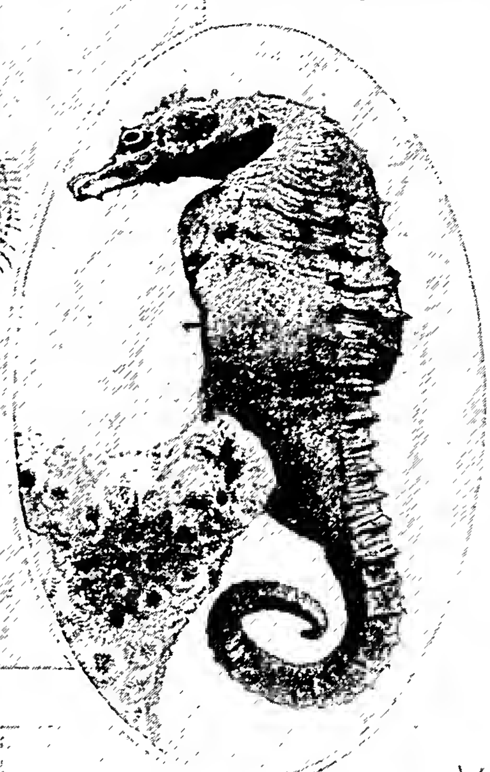
The dried bodies of sea cucumbers are used for soup in the Far East. The animals are also known as trepang, or *bêche-de-mer* (French for "sea caterpillar").

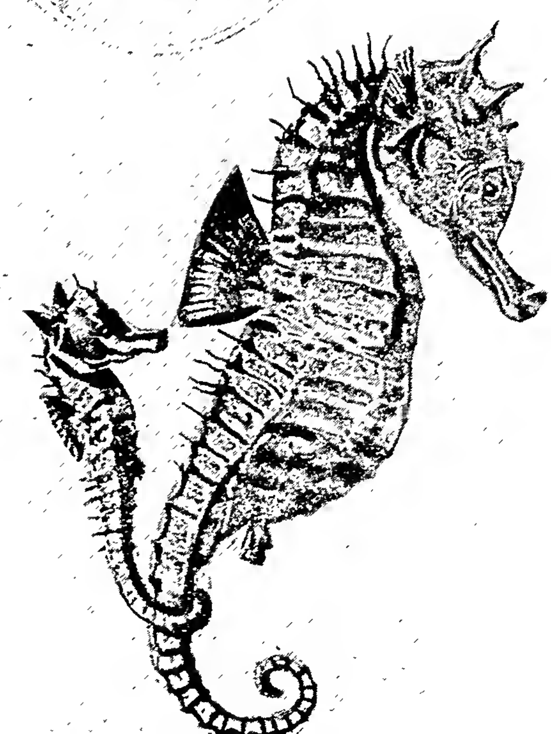
A SEA ANEMONE CATCHES ITS DINNER



A luckless fish swims close to a harmless-looking "flower" (left). The "petals" however, are tentacles. They throw out poisoned barbs and then grip the paralyzed victim (center). Now the sea anemone draws itself over the fish like a sleeve (right). Inside the gullet are many whiplike threads called flagella. Their movements draw the fish inside the body where it is digested.

A FISH WITH A HORSE'S HEAD AND A SNAKE'S TAIL





The upper picture (life size) shows the courtship of a pair of sea horses. This is quite a ceremony in which the male and female swim round and round each other. The female then deposits her eggs in the abdominal pouch of the male, where they remain about 45 days before hatching. To the right the father is "giving birth" to one of probably 200 baby sea horses. Below a youngster "hitches a ride" on the tail of one of its parents. Usually, however, the young must shift for themselves. This is not so dangerous as it seems, for other fish don't relish sea horses.

SEA HORSE. With a head shaped like that of a tiny prancing pony, a body encased in rigid plates and thorny spines, and a tail like a snake's there is little about the "sea horse" to suggest that it is really a fish. Nor do its habits follow those of other fish. It swims upright through the water with the aid of its single back fin. Usually, however, it remains hidden in seaweed, with its tail curled around a bit of the weed to keep from being swept away. Thus anchored, it looks like some strange pygmy dragon out of a fairy tale.

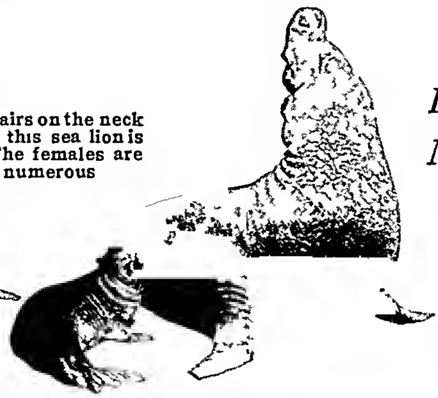
But perhaps the most peculiar thing about these creatures is the way they care for their eggs. The male carries them around in his "vest pocket," a sort of pouch like a kangaroo's, until they are hatched. Even after the young hatch out they remain in the paternal pouch for a time until they are old enough to forage about for themselves.

Sea horses are found in small numbers in nearly all of the warm and temperate seas. They belong to the pipefish family, but they are feeble swimmers. Clothed in bony plates and spines, and closely resembling in color the weeds among which they dwell, they are able despite their helplessness to escape their enemies. Their food consists of small sea creatures and the eggs of other fishes. They refuse to eat dead things.

There are some 50 species of sea horses, ranging in size from 2 to 12 inches. The common sea horse of the Atlantic coast of North America (*Hippocampus hudsonius*) reaches a length of about six inches. They are known as summer fishes; where they go in winter is a mystery. An olive green sea horse (*Hippocampus zosterae*), the smallest known species, is abundant in shallow water in the lagoons along the Florida coast.

LAND ANIMALS *That* TOOK *to the* SEA

The long hairs on the neck show that this sea lion is a male. The females are more numerous



How sea elephants acquire their name is clearly shown by the huge snout of the parent.

How the Seal Tribe Gained Flippers in Place of Legs and Now Feels as Much at Home in the Ocean as Any Fish

SEAL. On an ice floe in the Arctic sea an Eskimo stands waiting, harpoon in hand. At his feet is a hole he has cut in the ice. Down in it, sea water gurgles and swishes. The wind is bitter, but the hunter endures it, because he expects a seal to bob up in the hole to breathe. He must harpoon it in order to eat.

Before long he spears a seal, and then for a time he is rich. He saves the hide to furnish material for boots and a coat and to help cover a boat. His wife cooks the meat and serves the blubber, or fat, as dessert. She also burns some of the fat in a stone lamp to furnish light and heat.

Many Eskimos depend in this way upon the seal, though most of them use more modern methods of hunting (*see* Eskimos). Explorers too use seal meat and fat for food, fuel, and to feed dog teams. In milder climates, seals are hunted for oil. In most lands, sealskin coats, obtained from the fur seals of the North Pacific, are prized luxuries.

Seals are odd animals. First of all, they are mammals. This means that they have warm blood, they breathe air, and they bear living young on land. But they spend most of their time swimming like fishes in the water, hunting squid, fish, and shellfish. The seal can do this, though it is a mammal, because it is fully adapted to life in the water. A thick layer of fat protects the warmth in its blood. It can close its eyes and ears when it dives. The lungs hold air enough to permit staying under water several minutes.

Each leg has been made into a flipper for swimming. The forelegs are free from the body, and the seal can use them to pull itself along the ground. In some kinds of seals, the hind legs point forward and the animal can use them for getting about on land. In other kinds, the hind legs trail backward and serve only for swimming. These seals move on land like caterpillars by arching the back to draw the hind parts forward, then lunging ahead with the fore parts.

The Common, Harbor, or Leopard Seal

The best-known seal is the common, harbor, or leopard seal (because of its yellowish spots). Its skin is covered with coarse hair and is useless as fur. It is found on most ocean coasts, unless the water is warm. It swims short distances out to sea for food; otherwise it remains on the same rocky point or island For protection, it lives in small herds, but not in large rookeries. In early spring the young are born.

In North America common seals live along the Atlantic coast from the Arctic Ocean as far south as the Carolinas. They range the Pacific coast from Mexico to the Bering Sea, and they have been found in the St. Lawrence and Yukon rivers. In the days before kerosene was used for lighting, men hunted the common seal everywhere for its oil. Now the only big hunt occurs around Newfoundland in the spring.

The Migratory Fur Seal

Today the most valuable seal is the fur seal of the North Pacific and the Antarctic oceans. This seal belongs to the type which has useful hind limbs It is distinguished from others of this family because it has a soft, dense fur next to the skin. Coarse "guard hairs" grow through this and provide an outer hair coat like that of other seals.

HUNTING A SEAL

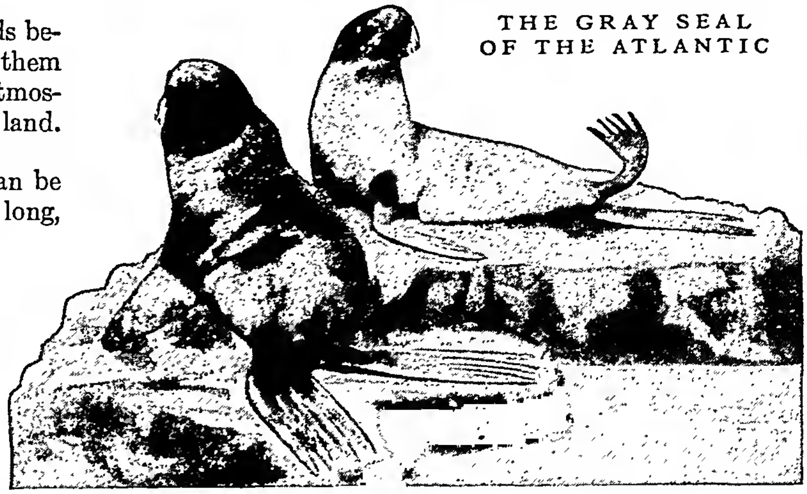
When a seal bobs up to breathe through the hole in the ice, the Eskimo will spear it. Then he will have food, light, and heat for a week.

Fur seals are noted for the great range of their migrations The full-grown males, or bulls, remain in the polar regions the year round, but the females and the young males migrate in winter almost to subtropical waters. The North Pacific herds go as far south as the line from San Diego to Shanghai (about 30° north latitude). In spring they go north for the summer breeding season.

By late May the bulls of these herds establish themselves on the Pribilof Islands of the United States, the Russian-owned Commander Islands, Kuril Islands, and

:obben Island. The seals like these islands be-
ause the frequent fogs that hang over them eep the sunlight subdued. This misty atmos-hcre prevents discomfort while they are on land.

THE GRAY SEAL OF THE ATLANTIC



These are hair seals, without a furry undercoat. We can tell that they are not fur seals because their hind flippers point backward. The yellowish-gray coat is often bedecked with darker spots. Gray seals are one of the largest species. The males grow to a length of ten feet or more; the females are much smaller.

The Breeding Season in the Rookeries

The bulls—seven years old or more—can be ecognized by their size. They are six feet long, veigh 500 pounds or more, and have 'wigs" of heavy hair over the head and he neck. Each bull takes a stretch of each as his own and keeps others away. As the young males, called "bachelors," arrive, the bulls force them to herd by themselves. In June the females, or 'cows," arrive, and 50 or 60 of them gather around each bull. Soon each cow which is three years old or more gives birth to one pup. Then the cows go to sea to feed, and return to nurse their pups.

In August the pups are old enough to learn how to swim and hunt. The mother pushes her pup into the water and lets it flounder until exhausted. Then she takes the pup under her flipper to rest. Within a week the pups can swim, play games, and begin to hunt. In September the females and the pups start south, and the bulls swim away.

Government-Controlled Sealing

On the Pribilofs the United States allows only three-year-old bachelors to be killed for their skins. The skin of younger ones is too small, and on older ones the fur is too coarse.

Before the killing starts, the officials estimate the size of the herd and mark one bachelor for every 40 three-year-old females by clipping off some fur. The native workers then drive all the bachelors to a convenient spot and kill the unmarked ones with a blow upon a weak spot in the skull. The hides are taken and sent in salt to the United States. The number taken has grown from 3,191 in 1912, the first year of government operation, to 60,000 or 70,000, as the herd increased under protection from about 200,000 in 1912 to about 4,000,000.

Dressing and Marketing Sealskins

All the furs are dressed for the government in St. Louis. After the skins are washed, stretched, and dried, the coarse guard hairs are removed. Most of them are scraped off with a dull, two-handled knife. The shortest ones are sheared off, after the underfur has been blown from beneath the shears with a strong blast of air.

Next the skins are placed in machines which work in oil and tumble the skins about to soften them. Then they are dyed a deep black or logwood brown and graded for quality. The finished skins are sold at auction. They range in price from $40 to $90 each. From five to eight go into one coat.

The Long Struggle to Save the Seals

The world still has these Pribilof Island seals because of one of the longest and hardest fights in all the

A SEAL ROOKERY ON THE PRIBILOF ISLANDS

Here are a few of the millions of fur seals that spend the summer on the Pribilof Islands in the Bering Sea. The large animals with up-reared heads are "bulls," keeping jealous watch over their wives; scattered through the throng can be seen a multitude of young seals, called "pups." The young males, called "bachelors," must stay away from the main herd and keep to a special path when they go down to the water to feed. If one strays from the path, the nearest bull attacks; and then comes a battle to the death.

THE FIRST OWNERS OF SEALSKIN COATS

Fur seals grow a soft undercoat beneath the surface guard hair, and this undercoat provides our highly prized sealskin You can see that these are fur seals because they have external coverings which close the ears, and their hind limbs point forward.

history of conservation efforts. When the United States bought Alaska from Russia in 1867, the Russians had learned to protect the seals against indiscriminate hunting. The United States tried to do this by granting a 20-year monopoly to a private company, in 1870 and again to another company in 1890. Each company tried to guard the herd in order to protect its business.

But many hunters killed seals while the herds were at sea This hunting, called "pelagic" (*pĕ-lăj′ĭk*) from a Greek word meaning "sea," threatened to exterminate the seals through loss of females The company appealed to the government, and in 1892 the United States asked Great Britain and Japan to join in forbidding pelagic sealing. But they would only agree to suppress hunting in a 60-mile zone around the Pribilof Islands.

By 1911 the herd was almost extinct, and Great Britain and Japan were willing to help save what was left. On July 7, 1911, they and the United States agreed to the North Pacific Sealing Convention, to become effective the following December 15 for 15 years. This treaty forbade pelagic sealing north of 30° north latitude, and left each government to regulate hunting on its islands. Each government agreed to share the hides taken on its islands, or the revenue from them, with the others The treaty was to be renewed automatically unless one of the nations denounced it.

The treaty allows Indians and Eskimos to kill fur seals, if they use nothing but native canoes and weapons. This hunting takes only a few thousand fur seals a year. American and Canadian Coast Guard vessels accompany the herd wherever necessary to enforce the provisions of the treaty The United States maintains officials and a few hundred Aleutian natives on the Pribilof Islands and visitors can land only with special permission. The government provides the natives with all necessities, schools, and medical attention, and pays a small sum every year as wages

Sea Lions and Sea Elephants

The fur seals have close relatives in the sea lions of the Pacific coast. These animals have external ears, like fur seals, but they have no underfur. The hair coat is glossy only when wet. Sea lions learn tricks readily; hence circuses and zoos use them for "trained seal" acts.

Sea lions are much like fur seals in their habits, except that they do not make extensive migrations There are two kinds, the common one, found from southern Mexico to northern California, and the larger Steller or northern sea lion This species ranges from about San Francisco northward to the Bering Sea

The giant of the seal tribe is the sea elephant, also called elephant seal There are two species, the northern and the Antarctic Males of the northern species may grow to be 18 feet long, the Antarctic ones grow slightly larger. In each species, the females are about half the size of the males The males have a short trunk, or proboscis, which they inflate when excited The northern species was common on the Californian and Mexican coasts until it was hunted almost to extinction for its oil. After Mexico began protecting the herd at its home on Guadalupe Island off Lower California, it again increased. The Antarctic species has become more numerous with protection.

WHO'S WHO AMONG THE SEALS

Seals, sea lions, and sea elephants belong to the order (or suborder) *Pinnipedia* and are grouped in two families, the *Otariidae* or Eared Seals and the *Phocidae* or Hair Seals. The *Otariidae* have external ears and their hind legs point forward. The *Phocidae* (also called "true seals") have no external ears and their hind legs point backward.

Otariidae

California Sea Lion (*Zalophus californianus*)—Brown to dull black; males about 8 ft long, about 500 lbs ; Pacific coast of North America

Steller or Northern Sea Lion (*Eumetopias jubata*)—Yellowish brown to dark brown, males from 1,500 to 1,800 lbs ; Bering Strait to California

Alaska or Northern Fur Seal, or Sea Bear (*Callorhinus alascanus*)—Soft underfur, 300 to 500 lbs

Phocidae

Common, Harbor, Hair, or Leopard Seal (*Phoca vitulina concolor*)—Yellowish gray to black, spotted with brown or yellow, about 5 ft long.

Ribbon Seal (*Phoca fasciata*)—Brown with bands of yellow about neck, shoulder, and rump; Aleutian Islands and Alaska coast.

Ringed Seal (*Phoca hispida*)—Dark brown, small yellowish rings, polar seas.

Greenland, Harp, or Saddle-Back Seal (*Phoca groenlandica*)—Males yellowish with bands of brown crossing over shoulders; about 6 ft long; polar seas

Bearded Seal (*Erignathus barbatus*)—Grayish to yellowish; long bristles around muzzle; from 10 to 12 ft. long, polar seas to Newfoundland.

Gray Seal (*Halichoerus grypus*)—Silver to gray, blackish spots, up to 10 or 12 ft long, Nova Scotia to Greenland

Hooded Seal (*Cystophora cristata*)—Slaty black spotted with whitish, males have inflatable bag of muscular tissue on top of head; from 7 to 8 ft long; Newfoundland to Greenland

Sea Elephant or Elephant Seal (*Mirounga angustirostris*)—Brownish to slaty, up to 20 feet long

SEASONS. The seasons affect almost every activity of human beings. Farmers plant and harvest crops in the warm months and cut wood and mend fences in the winter. Everyone changes to clothes of different weight and eats different sorts of food as the seasons change. We even play different games in each of the four seasons.

The seasons were much more important for our primitive ancestors, however, than they are for us. In winter people suffered terribly from the cold, and many starved when stores of food were used up. In spring those who survived the winter rejoiced at signs of life returning to the world. In summer they were grateful for the ripened fruits of the earth, and in autumn they felt real dread at the approach of cold and deadness.

We still call the seasons by names which dimly suggest our ancestors' feelings about them. *Winter* is an old Germanic word meaning "time of water"—of rain and snow—and *spring* refers to the springing forth of living things at that time. The original meanings of *summer* and *autumn* are lost in antiquity. Americans, however, generally call autumn by its more poetic name, *fall*, from "fall of the leaf."

The Year of the Seasons

The passing of the four seasons defines the length of the year. All calendars are based on this natural interval, often called the *year of the seasons* (*see* Year; Calendar). Before men had calendars, they watched the sky to forecast the approach of each of the seasons. When they saw certain stars in the sky at nightfall, for example, they knew that spring was at hand. Then they could confidently plant early crops even though the weather still seemed wintry.

Even today people can keep track of the year of the seasons by watching the stars. When persons in the Northern Hemisphere see the bright star Regulus in the east at nightfall, they know that winter is almost over. Blood-red Antares signals the approach of summer, and the square of Pegasus means that fall is coming soon. When we see the familiar twinkling Pleiades with the beautiful star Aldebaran hanging below them in early evening, we may be sure that winter is almost upon us.

The Sun and the Seasons

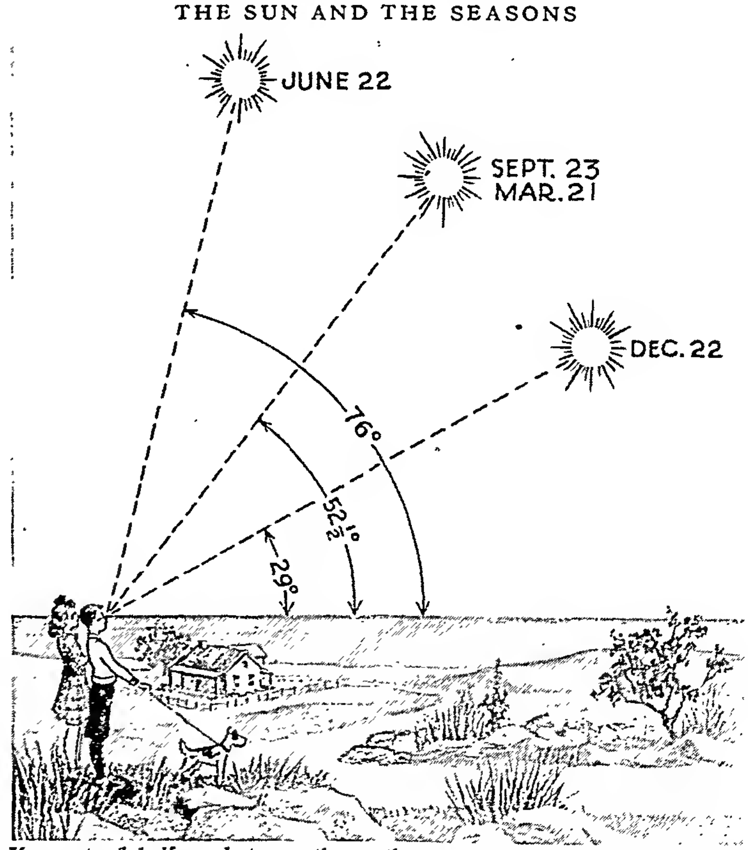
Men have always watched the sun also for signs of the passing seasons. People living in the Northern Hemisphere early learned that the noon sun is highest in the sky about June 22, lowest about December 22, and at a middle height about March 21 and September 23. They knew that the high noon sun brought many hours of daylight and the low sun few. They realized also that the midway points gave days and nights of almost equal length.

Two facts account for the changing position of the sun. First, the earth revolves around the sun once during the year while rotating daily on its own axis. Second, the earth's axis is tilted about $23\frac{1}{2}$ degrees from the vertical. Thus in June the Northern Hemisphere is tipped slightly toward the sun and the Southern Hemisphere is tipped away from the sun. In December the opposite is the case, and in March and September both hemispheres are equally exposed to the sun. (For diagrams, *see* Earth; Astronomy.)

These motions give us the seasons. When our Northern Hemisphere is tipped toward the sun, the sun appears to trace for us a high path across the sky. Its rays are then more nearly direct and hence more intense than slanting rays. The days are long, the earth absorbs a great deal of heat, and summer comes. When the hemisphere is tipped away from the sun, these conditions are reversed. The weather grows cold and winter arrives. Since the Southern Hemisphere is always tipped in the opposite direction, people in southern lands have their summer in December and their winter in June. On the equator there are no real seasons.

The days on which the sun is highest and lowest in the sky are called the *solstices*, and the days on which it is midway between are the *equinoxes* (*see* Equinox and Solstice). These days mark the beginning of each season. The coldest days of winter come after the sun has reached its lowest noon position and the earth slowly gives up heat absorbed in summer.

THE SUN AND THE SEASONS



If you stood halfway between the northern and the southern limits of the United States—at latitude 37½° N.—you would see the noon sun at these different heights above the horizon on these dates. On which dates would you cast the longest shadow and the shortest?

In summer the earth absorbs heat just as slowly, and the hottest days are similarly delayed.

Plants and Animals

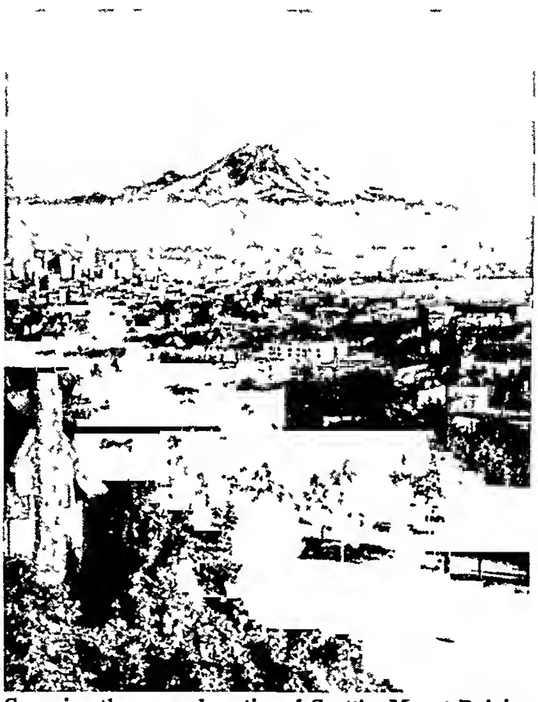
Of all living things on earth, the plants are most affected by the seasons. In spring their leaf and flower buds open, fertilization takes place, and new rings start under the bark of trees Summer is the time of plant growth in the long hours of sunshine that provide energy for photosynthesis (*see* Plant Life). Autumn is the time of ripened fruits. Then leaves, their service over, dry colorfully and fall (*see* Leaves). Winter is a time of death for many plants and of resting for the others. Buds are tightly waxed to keep out the ice, and seeds have hard coats for their protection. (*See also* Flowers; Trees.)

Many animals are greatly affected by the seasons Birds migrate to escape the cold, and nearly all furry creatures get new, thick coats in autumn. Many eat to fatness and then sleep through the winter (*see* Hibernation). Creatures that neither migrate nor hibernate seek protection. With the coming of spring, birds, insects, reptiles, and mammals multiply. Summer is a working time and autumn a feasting time for all the animals. Some of them—chiefly the insects—cannot live through the winter, but their eggs or pupas are well protected (*see* Insects).

SEATTLE—METROPOLIS *of the* NORTHWEST

SEAT'TLE, WASH. To understand the greatness of Seattle, a visitor needs only to approach the city from the Pacific Ocean through Juan de Fuca Strait and Puget Sound. As he travels southward along the sound, between the snow-capped Olympic Mountains on the west and the towering Cascades on the east, he sees ships everywhere. These ships are one key to the city's importance and rapid growth.

Some of them carry most of the trade between the United States and Alaska. Others ply between Seattle and other Pacific coast ports, to Atlantic ports and Europe through the Panama Canal, and to South America. Still others normally carry a huge Oriental trade, because Seattle is the nearest American port to Japan and China.



Crowning the many beauties of Seattle, Mount Rainier rears its snow-clad head some 60 miles to the southeast. This view was taken from Queen Anne Hill, looking over the central business district toward the mountain.

Scenery and Climate

As the visitor draws near Seattle, about 125 miles by water from the ocean, he gets a superb view of its beauty and natural advantages. It stands on a ridge of hilly land between Puget Sound on the west and Lake Washington, an expanse of 38 square miles of fresh water, on the east. Dominating the scene is Mount Rainier, a glacier-ridged extinct volcano 14,408 feet high, about 60 miles to the southeast. Mount Rainier is one of the most majestic of American peaks, because its lofty cone rises almost from sea level.

Mount Rainier, the Olympic Mountains to the west, and the Cascades on the east offer the finest camping, fishing, and hiking in the summer, while unmelting snow on the peaks offers winter sport the year round. Puget Sound and Lake Washington give innumerable opportunities for water sports. These recreational advantages can never be reduced or spoiled, because the Mount Rainier and Olympic areas are national parks and most of the Cascade Range is within the Mount Baker, Columbia, and Snoqualmie national forests

Everyone can enjoy these advantages the year round because of the favorable climate. The nearby ocean prevents extremes of heat and cold. Many winters pass without snow. The temperature never drops to zero in winter or reaches 100°F. in summer. Ample precipitation provides rich growth of plants, trees, and flowers Two thirds of it occurs between October and March.

FACTS ABOUT SEATTLE

Population: 467,591 (1950 census); metropolitan area, 732,992. Growth of city: *1870*, 1,107; *1880*, 3,533; *1890*, 42,837; *1900*, 80,671; *1910*, 237,194; *1920*, 315,312; *1930*, 365,583; *1940*, 368,302.

Area (Land): 70.9 square miles; metropolitan district, 2,136 square miles.

Climate: *Mean temperatures*—daily high, 72.4°F. (July), low, 36.0° (Jan.); monthly high, 64.4° (July, Aug.), low, 40.4° (Jan.); annual mean, 52.3°. *Precipitation*—annual, 33.44″; monthly high, 5.95″ (Nov.), low, 0.23″ (June).

Principal Water Shipments: Lumber, grain, flour, fruit, paper, coal, steel-mill products, iron and steel semimanufactures.

Principal Manufactures: Shipbuilding and repair; aircraft manufacture; lumber and allied products; aluminum fabrication; grain products.

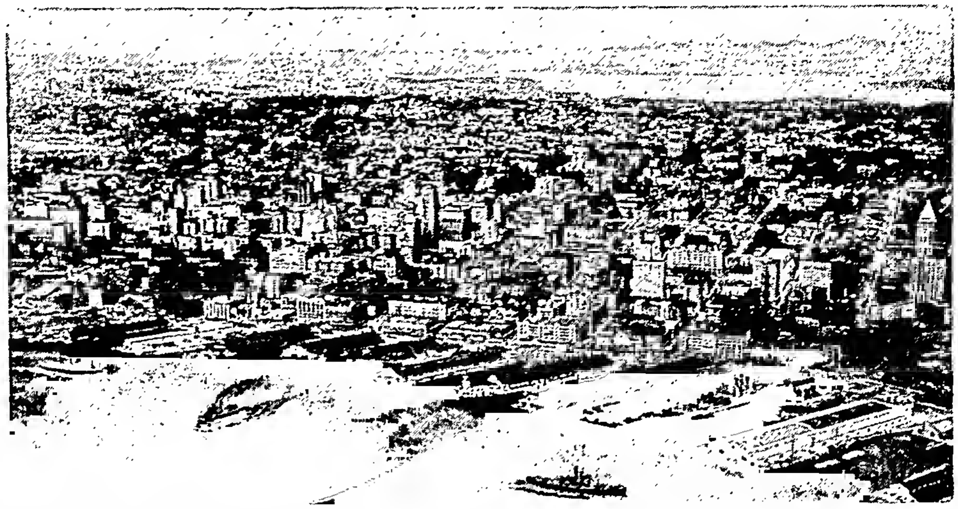
Trade and Industry

Seattle's business advantages rival its beauty. The principal business and shipping district stands where Elliott Bay bites into the land from the sound, and provides salt-water wharfage for about 75 full-sized vessels at a time. A canal,

opened in 1916, gives access to the lake. Ships enter the canal through a lock 825 feet long, 80 feet wide, and 29 feet deep at low tide. The only larger locks are those at Sault Sainte Marie, in the Welland Ship Canal, and in the Panama Canal.

Connections by land are provided by four railroads, eight air lines, and a network of roads. In 1940 Seattle completed the world's longest concrete pontoon bridge across Lake Washington, shortening travel time east. In 1950 it completed Agate Pass Bridge to the fine residential area on Bainbridge Island in Puget Sound.

SEATTLE'S BACKGROUND OF LAKE AND MOUNTAIN



This airplane view, taken from above Puget Sound, looks northeastward across Seattle to the snow-capped Cascade Mountains. At the far left is Mount Baker, about 90 miles away. In the near right background is the 26-mile stretch of Lake Washington; in the foreground, at the extreme right, is the city's tall Smith Tower. Along the water front are Seattle's many wharves.

Most of the industries are on the Lake Washington Canal, the water front, and the Duwamish Waterway, a canalized river through the south part of the city. Probably the best-known industry is the Boeing Aircraft Company. It was started during the first World War by William E. Boeing, the son of a Seattle lumberman. The company has pioneered and led in producing every type of airplane, especially large transports, flying boats, and heavy bombers.

Electric Power from Mountain Streams

The city provides a great aid to industry with cheap hydroelectric power from the Cascades. To obtain this power the city developed the Skagit River in northern Washington in three steplike stages: the Gorge Dam, nearest the sea, completed in 1924; the Diablo unit (1930) halfway up; and the Ross Dam on Ruby Creek, started in 1938 to impound flood water high up in the mountains and completed in 1949. Release of water during the year generates 1,120,000 horsepower. The city-owned traction system was modernized in 1939 with motor and trolley buses. The city's water supply comes from the Cedar River in the Cascades.

A daring improvement, completed early in the 20th century, was the removal of Denny Hill, an obstacle to the northward expansion of the central district. The entire hill was washed into Elliott Bay, and the material was used to increase harbor facilities.

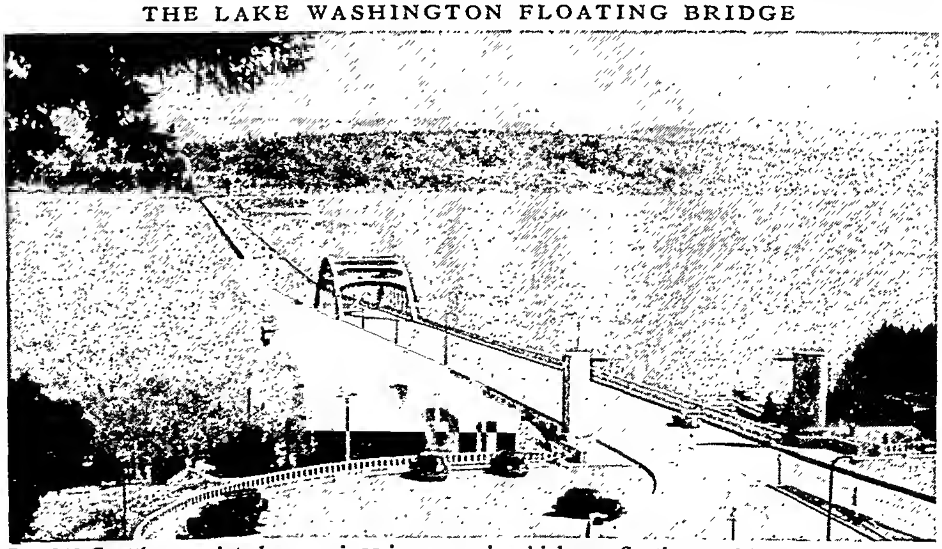
Points of Interest

The municipality has more than 40 parks, large and small, and more than 50 playgrounds; it also maintains municipal golf courses, museums, and a zoo. Volunteer and Kinnear parks contain hills which afford superb panoramas of the city and surrounding country. Roosevelt Park preserves an area of natural forest land. The city also contains Green Lake, adjoining Woodland Park, and Lake Union, a part of the Lake Washington Canal. A municipal auditorium seats 6,500 and an adjoining arena, 4,500. A noted private structure is the 42-story Smith Tower, which is in the central district.

The University of Washington occupies a beautifully wooded 582-acre campus along the ship canal near Lake Washington. The United States Army maintains Fort Lawton within the city limits, and the Navy has an airport on Lake Washington.

Seattle takes pride in the fact that about half the homes in the city are owned by their occupants. Most

THE LAKE WASHINGTON FLOATING BRIDGE



In 1940 Seattle completed an engineering marvel, a highway floating on 25 concrete pontoons across Lake Washington. Formerly motorists drove around the lake. The bridge is so rigid that a storm does not move it more than an inch. The bridge project is about 6½ miles long, including a tunnel, roads, 2,022 feet of approaches, and 6,561-foot floating section.

of the residential sections have unusual charm, thanks to many hills and because the favorable climate makes it easy to maintain trees, fine lawns, and a wealth of flowers. Seattle also claims to have one of the lowest city death rates in the country.

The Story of Seattle's Rapid Growth

Seattle's history started Sept. 28, 1851, when a few settlers built homes on the north shore of Elliott Bay. Next year they moved to the site of the present central district. The town was named for a friendly Indian chief; it was incorporated as a city in 1869.

Growth remained slow until the start of transcontinental train service in 1884. Two years later a fire swept the business district; but this gave a chance to build anew when rapid growth began. The start of transpacific steamship service in 1896 and the first shipment of gold from Alaska in 1897 produced more than a fivefold increase in population between 1890 and 1910. Thereafter growth was supported by development of the surrounding territory and opening of the Panama Canal in 1914. The Alaska-Yukon-Pacific Exposition was held on the present site of the University of Washington in 1909.

SEAWEED. A floating meadow of seaweed almost as large as a continent lies between America and Africa in the North Atlantic Ocean. This is the famous Sargasso Sea. Columbus discovered it as he sailed toward the New World in 1492. The tangled, shifting mass is a resting place for the wandering albatross and petrel. It is the home of tiny fishes, mollusks, crabs, jellyfish, sea worms, and other many-colored deep-sea creatures.

People used to believe that the Gulf Stream carried weeds to the Sargasso Sea from the shores of the West Indies and the Bahamas. They believed this because most seaweeds are found attached to rocks along seacoasts unless waves tear them loose. Today scientists consider it more likely that the weeds of the Sargasso Sea are free-floating varieties. According to this theory, they grow in the region.

Most of these weeds are species of *Sargassum*, popularly called "gulf-weed." This is a long, many-branched plant buoyed up by little air-bladders that look something like grapes. Many other kinds of seaweed are found all over the world, growing in both fresh and salt water. They are blue-green, green, brown, and red; and range in size from the little blue-green slimes found on ponds to the giant kelps, sometimes 150 feet long, with tough, leathery, rootlike branches.

They are useful as well as interesting and beautiful—these plants of the lakes and ponds and rivers and sea. Not only do they form breakwaters that prevent the wear and tear of waves on the coast, and sometimes make natural harbors; not only do they serve the useful purpose of throwing off oxygen and keeping the water pure; but they also form the real basis for ocean life, since the larger water creatures live on the smaller ones, which feed upon seaweed.

SOME OF THE VARIED FORMS OF SEAWEED

1. The *Iridea edulis*, better known as Hide-Weed. 2. Carrageen or Irish Moss, an edible variety of the red seaweeds. 3. Rock weed (*Fucus vesiculosus*), one of the brown seaweeds. 4. Sea Lettuce (*Ulva latissima*), a green weed. 5. Deadman's Hand (*Laminaria digitata*). 6. Wingweed (*Laminaria esculenta*). Both the Deadman's Hand and the Wingweed belong to the group known as kelps.

SEA URCHIN. This small sea animal, with its spiny shell, is closely related to the starfishes. There are many varieties of these interesting creatures found among the rocks along the seashores and on the ocean bottom. The common green sea urchin (*Strongylocentrotus drobachiensis*) of the rocky New England and Pacific coasts is a round cushion-shaped creature with a shell of beautifully patterned limy plates underneath its thicket of spines. The smooth flat sand-dollar (*Echinarachnius parma*) is another familiar form found on sandy shores and admired for its curious markings. (*See* Starfish and Sea Urchins.)

Kelp ash was formerly an important source of the alkalis used in manufacturing soap and glass, and the chief source also of iodine; but nowadays its chief value is as a fertilizer, since its rich potash content makes it a valuable enricher of worn-out soils. Many varieties of seaweeds, such as "Irish moss" or carrageen, are edible, containing a considerable proportion of gelatinous nutriment. Cattle and horses used to rough pastures thrive on it, and we also like it in blanc mange, and in jellies and soups. Many thousands of pounds of Irish moss are gathered at low tide along the rocky coasts of Ireland and Massachusetts Bay. When the tide rises the people go out in small boats and gather in the moss with rakes. Sometimes seaweed is used by upholsterers for stuffing mattresses, chairs, and couches; sometimes it is used in the manufacture of paper; sometimes it makes a kind of gelatin; and sometimes all sorts of little dolls and baskets and trinkets are formed out of dried kelp. The gigantic kelps along the northwest coast of America were once used by the natives for ropes, and the huge bladders, as large as kegs, served as water bags.

The term seaweed includes the simple kinds of algae, but not aquatic mosses, liverworts, fernworts, and flowering plants (*see* Algae).

SECRETARY BIRD. As snake killers, secretary birds are of great value in their native home of South Africa. They are protected by law and farmers often keep them about their premises to destroy vermin, for their diet includes frogs, insects, lizards, and small tortoises, as well as snakes.

FOE OF SNAKES

The secretary bird is not as mild as his name might indicate. This one is toying with a snake, a delicacy of which the bird is very fond.

Secretary birds (*Sagittarius serpentarius*) are perhaps so called because of a tuft of quill-like feathers projecting from the back of the head and neck, making the profile view resemble that of a clerk or secretary with a number of quill pens behind his ear. They are also called "serpent eagles." The birds have very long legs and are about four feet high, with a tail that reaches the ground. The beak is strong and hooked, and the plumage is bluish gray and black. They run with the speed of a horse, and when forced to do so will take to the air and fly to considerable heights. They build bulky nests in trees or bushes. The secretary bird forms a family by itself, related to the vultures.

SEDAN, FRANCE. It was Nov. 7, 1918, four days before the armistice that ended the first World War. American troops of the First Army, by the great battle of the Argonne, had cut the German communications and brought the town of Sedan under their guns. Now the doughboys of the "Rainbow Division" stood lined up by the roadside, ready to march across the Meuse and carry the Stars and Stripes into the town.

But before they entered, they sent ahead of them a column of French soldiers. The town of Sedan had been a symbol of disaster for France for many years. There, 48 years before, the last desperate battle of the Franco-Prussian War had been fought, in which Napoleon III and 86,000 men surrendered to the Germans. So the Americans stood aside and allowed the French to enter and claim Sedan first. In 1940, during the second World War, the Germans recaptured Sedan, which they held until driven out by the Allies in 1944. During the savage fighting in this area, the city suffered severe damage.

Sedan is situated on the right bank of the Meuse River, 64 miles northeast of Reims. It has coal and iron mines, and it manufactures cloth, machinery, and flour. Population, (1946 census), 12,987.

The *sedan chair*, contrary to popular belief, did not get its name from this city but rather from a Spanish word meaning "chair" or "saddle." This form of conveyance, which was popular in Europe in the 17th, 18th, and early 19th centuries, had a closed, upholstered body seating one person and was carried on poles by two bearers. From its name we get the term *sedan* for a closed automobile with a single compartment.

SEDGE. The sedges form a large family of plants closely resembling the grasses and rushes. They grow in marshes, on the seashore, along river banks, and in other low, moist places throughout the tropical and temperate parts of the earth. They differ from grasses in having solid, usually triangular stems. The grasslike, green leaves are in three rows instead of two as in the grasses. The leaf sheaths grow together into a tube around the stem, whereas in grasses they are split on one side. Many sedges are called rushes or bulrushes. But the true rushes belong to a different family, *Juncaceae* (*see* Grasses; Rushes).

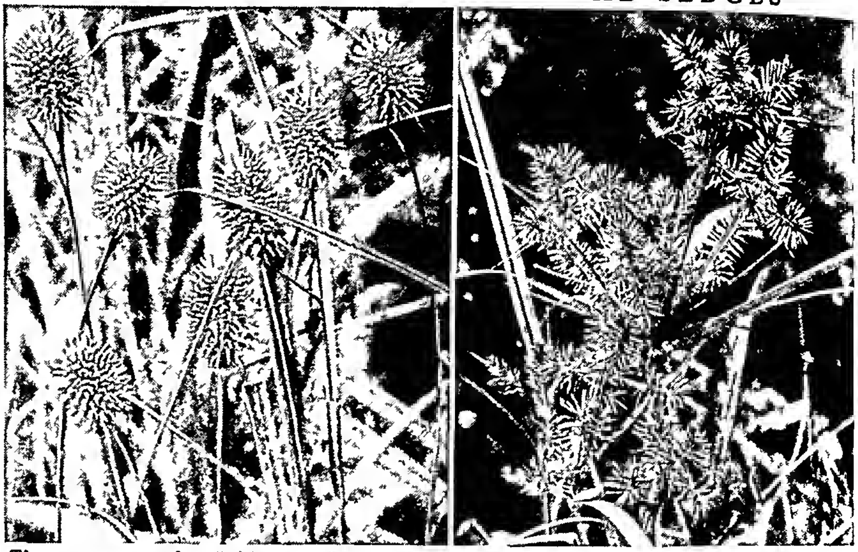
The tiny flower of the sedge consists only of stamens and pistils, enclosed in a scale. The scales are gathered in dull green or brown spikes, like the heads of wheat or oats. The spikes are often arranged in erect or drooping clusters.

The sedge family (*Cyperaceae*), comprises about 75 genera. The largest genus is *Carex*. Almost 900 species grow in cool, temperate climates. Many grow on dry land, but they are the commonest plants of marshy meadows. They are sometimes used in making "grass carpets."

The genus *Cyperus* has about 600 species, many of them tropical plants. The papyrus of the Nile River is a cyperus sedge (*see* Papyrus Plant). The umbrella plant (*C. alternifolius*), used in ornamental plantings, is also an African species. Chufa, or earth almond (*C. esculentus*) has edible nutlike tubers. The spikes of cyperus cluster on branches that radiate from the top of the stem and are surrounded by leaves at the base of the flower cluster.

The genus *Scirpus* includes about 150 species of club rushes and bulrushes. They vary greatly in appearance. Some are low and slender; others are broad-leaved and bear attractive clusters of spikes. The great bulrush (*S. validus*) grows to nine feet in height, with a stem an inch in diameter at the base. Mats and ropes were once made of the bulrushes. The chairmaker's rush (*S. americanus*) was used in colonial days to make chair bottoms. Wool grass (*S. cyperinus*) has long, downy, gray spikelets. Cotton grass, with soft, downy, white bristles, belongs to a fourth genus (*Eriophorum*). There are 12 species of cotton grass native to the Northern Hemisphere.

GRACEFUL SPIKES OF THE SEDGES



The squarrose sedge (left) belongs to the genus *Carex*. On the right is the red-rooted cyperus The sedges are so numerous that few of them have common names.

SEEDS. Flowering plants make new plants by means of their seeds. Inside the seed is a baby plant, called the embryo. In the ground, under the right conditions of warmth and moisture, the embryo begins to grow. It breaks out of the seed coat and pushes up through the soil into the sunshine. It develops into a plant which in turn will produce new seeds. (For the story of how flowers make seeds, *see* Flowers.)

When the seeds are ripe they must leave the parent plant. Every seed has some way of traveling. Some may travel only a few inches. Others may travel many miles. If they all fell to the ground directly beneath the parent, they would be too crowded and too shaded to grow. They must find good soil and plenty of space and sunshine if they are to develop into strong, healthy plants.

How Seeds Are Scattered

Many seeds are adapted to riding in wind currents. Dandelions, milkweeds, cattails, thistles, and asters have seeds with fluffy little parachutes. They drift through the air on the slightest breeze if the air is dry. On damp days the parachute stays closed. Seeds may travel many miles on their parachutes.

Some seeds are enclosed in dry husks equipped with one or two propeller blades. The maple, ash, and ailanthus trees have such fruits. They twist and turn in the air and may sail a short distance from the parent tree. Other plants have winged seeds. Among them are the catalpa, birch, and elm trees, and the trumpet creeper. The seeds of the orchids are so fine and light that they blow about like dust.

The long stiff beards of the grains and grasses act like kite tails, or they steal a ride on some animal's coat. Certain plants break loose from the soil in the autumn. The entire plant rolls before the wind, scattering its seeds over the countryside. One such plant is called a tumbleweed.

The fruits of plants growing in or near the water may wear buoyant, waterproof coverings that let them float. Many a tropical island has been planted with coconuts brought to it by the ocean tides (*see* Coconut Palm).

There are fruits that scatter their seeds by literally exploding. The pod bursts open and forcibly shoots the seeds in all directions. Wood sorrel, jewelweed, or touch-me-not, witch hazel, bergamot, and pansy are familiar examples. In the West Indies the "monkey dinner bell," or sandbox tree (*hura*), explodes with a report like a pistol shot.

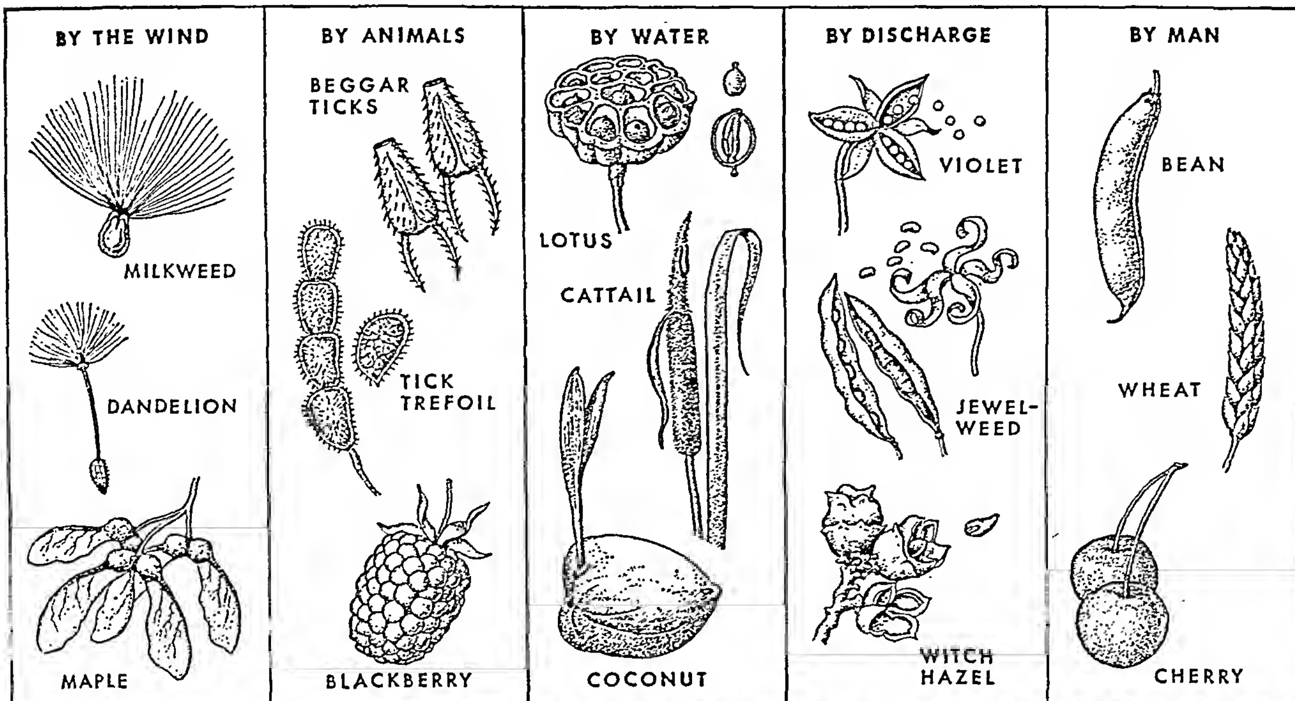
Animals are important seed carriers. The seeds catch in their fur, or on the clothing of human beings, by means of grasping hairs, bristles, hooks, or barbs. Such seeds are the beggar-ticks, burdock, cocklebur, and tick trefoil. Water birds carry the seeds of water plants, sedges, and grasses in the dried mud on their legs.

To attract hungry creatures, many seeds are sunk in the flesh of delicious, gaily colored fruits. The sticky fruit of the mistletoe smears on the bird's beak or feet, to be wiped off on a tree many miles away. Seeds such as cherry pits pass through the digestive organs uninjured. Birds scatter the seeds of many berries and other fleshy fruits in this way (*see* Birds). Squirrels, chipmunks, and other animals collect nuts and seeds in their burrows. Man himself is one of the most important factors in the spread of useful seeds throughout the world. But he has also scattered many harmful weeds that were present as impurities in crop seed.

Economic Importance of Seeds

Man finds many uses for seeds. Grain seeds such as rice, wheat, corn, barley, oats, and rye are the basic foods of all peoples. The seeds of mustard, nutmeg, caraway, coriander, celery, and anise are used as spices. From coconuts, cottonseed, corn, flaxseed, peanuts, olives, castor beans, soybean

SEEDS TRAVEL IN MANY DIFFERENT WAYS



Seeds with fluffy parachutes, wings, or tiny propeller blades sail on the wind. Animals carry off barbed and sticky seeds on their coats or eat the fruit and berries in which they are enclosed. The seeds of water plants are able to float. Some plants, at a touch, shoot their seeds with explosive force. Man scatters the seeds of food plants in fields and gardens.

seeds, and almonds, we get valuable oils. These oils are used in making soaps, varnishes, paints, and linoleum (*see* Fats and Oils).

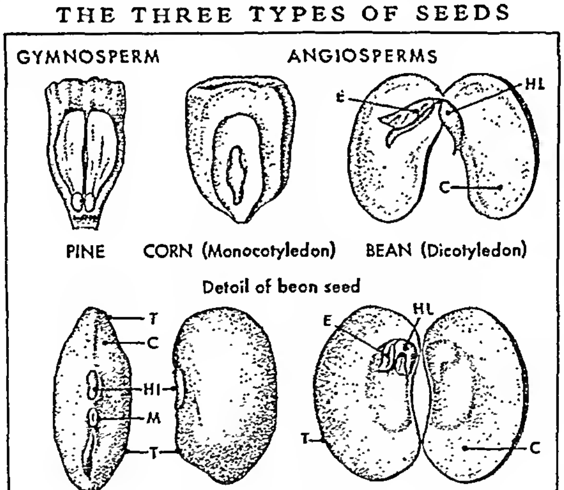
Commercial seed growing is an important industry. The wholesale value of seeds sold for planting in gardens and farm fields is about 100 million dollars annually. Seeds shipped in interstate commerce must meet certain standards set by the Federal Department of Agriculture. Packages must bear labels which give the percentage of seed guaranteed to germinate, the percentage of weed seed present, and other information to protect the buyer. Samples of imported seeds must be tested by the Department before they can be released for sale.

Botany of the Seed

The origin and growth of seeds in plants is explained in the article on Flowers. It tells how pollen lodges on the stigma of a flower, how the pollen tube grows down through the pistil, and into the ovary and the egg cell, or ovule, inside the ovary. When the contents of the pollen tube enter the ovule, the flower is said to be fertilized.

Important changes begin to take place. The ovary, or seed case, may turn into a fleshy, pulpy fruit, or into a dry pod, capsule, or nut. The wall of the ovule hardens and becomes a protective coat called the *testa*. Inside the testa is the embryo, or young plant. Now the ovule is called a seed. A botanist defines a seed, therefore, as "the ripened ovule of a flowering plant." The development of the seed stops and it goes into a period of rest. It starts growing again, or *germinates*, after it has been planted.

THE THREE TYPES OF SEEDS



In the upper row are the three kinds of seeds. The two ovules of the pine lie exposed on a scale. Hence it is called a gymnosperm, meaning that it has "naked seeds." Angiosperms have "enclosed seeds." In a monocotyledon like corn the enclosing cotyledon is single. In a dicotyledon such as the bean plant, there are two cotyledons. Below is a bean, seen edge on, sideways, and cut open. Letters point to the testa, T; cotyledons, C; hilum, HI; micropyle, M; epicotyl, E; and hypocotyl, HL.

Plants whose seeds are protected inside an ovary are called *angiosperms*. The word means "enclosed seeds." Some seeds lie exposed on the surface of a scale. Plants with such seeds are called *gymnosperms* (meaning "naked seeds").

The pine tree is an example of a gymnosperm (*see* Flowers). On the surface of each scale of the female cone are two cavities, each containing an ovule. In the spring the scales spread open to receive the windblown pollen from the male cones on the same tree. When a pollen grain falls between two scales it sends out a pollen tube and fertilizes an ovule. The scales then close to protect the ripening ovule, or seed. In late fall or winter the cone dries up, the scales again open, and the seeds are released.

To get an idea of how a seed is made, look closely at a bean or a pea. On the outside of the seed coat is a scar called the *hilum*. Here the seed was attached to the wall of the ovary, which became the pod. Near one end of the hilum is a tiny opening called the *micropyle*. Through this opening the pollen tube entered the ovule. The growing plant bursts out of the seed coat through this same opening.

Now remove the covering, or testa, of the seed. The young plant inside is called the *embryo*. It has two main parts which can be separated easily. These are seed leaves (*cotyledons*). They are present to provide nourishment for the plant when it first breaks out of its seed coat and before it has had time to establish its roots or make its own food.

Now examine a kernel of corn. Its embryo has only one cotyledon. This difference is so important that botanists classify all plants with enclosed seeds (*angiosperms*) according to the way their seeds are made. Those with two seed leaves are called *dicotyledons;* those with one are *monocotyledons*. The seeds of gymnosperms may have several cotyledons.

The seeds of corn and other grains and grasses have another difference. Their embryo is surrounded by a starchy tissue called *endosperm*. It too serves the embryo as a food supply. In peas, beans, and other legumes, the endosperm is entirely absorbed by the ripening ovule. In the grasses, the endosperm is not used by the embryo until germination begins—that is, after it has burst out of the seed coat and begun to grow.

Attached to the cotyledons are two important structures. Beneath the cotyledons is the *hypocotyl*. Its tip, called the *radicle*, is the first true root of the plant. The radicle is always directed toward the micropyle and is the first part of the embryo to break out of the seed coat. Above the cotyledons is the *epicotyl*. It produces the stem and leaves. (The picture in the article Bean shows what happens when a bean seed germinates.)

Unless conditions of warmth and moisture are right, seeds will not germinate. How long do they remain alive (*viable*), waiting to continue their growth into plants? The extreme duration of viability for any known seed seems to be between 150 and 200 years. Lotus blossoms have been grown from seed 150 years old. Many weed seeds remain viable for 20 to 40 years in the soil.

SEINE (*sān*) **RIVER.** Among the historic rivers of France, the Seine is the best known, chiefly because the city of Paris stands along its banks. The Seine rises from six little springs among the wooded hills of the old duchy of Burgundy in eastern France. After winding and twisting its way northwestward through a course of 482 miles, it falls into the English Channel between the ports of Honfleur and Havre. In a direct line the source of the Seine is only 250 miles from its mouth, but the river doubles back and forth until it measures almost twice that distance. Along its course, ancient battlegrounds, grim feudal castles, and medieval monasteries intermingle with modern mansions and widespreading forests. Before reaching Paris about 230 miles from the mouth, it passes such famous cities as Melun and Fontainebleau, while below Paris are St. Denis, St. Germaine, and Rouen.

The Seine near its source is a puny rivulet that in summer sometimes becomes quite dry. As it receives in turn the waters of the Aube, the Yonne, the Oise, and the Marne, it develops into one of the four important rivers of France, furnishing water power for numerous large industries. It is navigable for small vessels for some distance above Paris. The low elevation of the hills which bound its basin makes it comparatively easy, moreover, to connect the Seine and its tributaries, by means of canals, with the Somme, the Scheldt, the Meuse, the Saône, and the Loire. Deep dredging from its mouth to Rouen, a distance of about 50 miles, has made that city a seaport and has reclaimed 28,000 acres of land.

SELENIUM. "If anyone were to strike a match on the moon, we could probably discover the fact on earth by means of selenium." This statement, made by an enthusiastic scientist, may be an exaggeration, but it suggests dramatically selenium's peculiar powers. This comparatively rare element was first isolated by Berzelius, famous Swedish chemist, in 1817. Its photosensitivity was not discovered, however, until half a century later.

In the dark, selenium is a poor conductor of electricity. But if a beam of light strikes it, its conductivity instantaneously increases in direct proportion to the light's intensity. Inclosed in a suitable cell to shut out other influences and connected in an electrical circuit with a galvanometer, a thin film of selenium becomes, therefore, a device for measuring the brightness of any light that passes through the cell window. Furthermore, it enables us to translate variations of light into variations of electric current, which can in turn be translated into sound by telephonic methods.

After he invented the telephone, Bell experimented with the "photophone," in which the voice made a beam of light vibrate over a distant selenium cell receiver. The "optophone" and "phonopticon" are selenium devices to help blind people to read. They "hear" the light variations coming from the letters.

Selenium cells have been used to measure sunlight, moonlight, and the feeble rays from stars beyond our ordinary vision; to control traffic lamps and to turn harbor beacons on at night and off at dawn; and to transmit pictures by wire and radio. In recent years, however, their place has been largely taken by photoelectric cells because the latter are usually more rapid in their response to light changes (*see* Photoelectric Devices). The chemical properties of selenium are useful in controlling the color of glass. In small quantities it yields a pink tinge that counteracts the green from iron impurities. In larger quantities it produces the kind of red glass used in automobile taillights. Some enamels and pigments are made with selenium compounds. Most of the world's selenium is a by-product of copper refining.

SENSATION AND PERCEPTION. We are aware of the roar of a jet plane, the blueness of the sky, the warmth of the sun, the odor of perfume, the taste of chocolate, the weight of our books, the tightness of our clothes. Every moment of our waking life is crowded with such experiences. We are also aware of inner happenings. Our throat feels dry, our stomach is empty, and our muscles are tense. All such experiences are known as *perceptions.*

Most perceptions are a combination of different kinds of *sensations.* An apple has color, taste, smell, and feel, all of which are sensations. When we examine an apple we are not aware of the separate sensations, but we *perceive* the apple as a whole.

Sensations can be experienced at birth or shortly after. If a light is held before a baby, he sees a bright spot, as an adult does. However, the spot does not suggest "light" to him. He hears a loud roar, but it does not mean "jet plane." These meanings must be learned and remembered.

The first time a child receives a stimulation, such as the light, he experiences a *sensation.* When the stimulation is repeated and he recognizes the object, he experiences a *perception.* The difference between sensation and perception is thus a matter of meaning and complexity. Some psychologists define sensations as "meaningless bits of experience" out of which meaningful and complex perceptions are put together.

Sensations are experienced when a sense organ such as the eye, ear, or skin is acted upon by some form of stimulus such as light, sound, or pressure. The stimulus acts upon nerve endings called *receptors.* When a receptor is stimulated, a message called an *impulse* travels over a nerve fiber to the brain (*see* Nerves). The activity in the brain, caused by the impulse from the receptor, results in a sensation. If the brain adds nothing from memory or understanding, the experience remains a sensation. If the brain adds something, the experience becomes a perception.

Images and Feelings

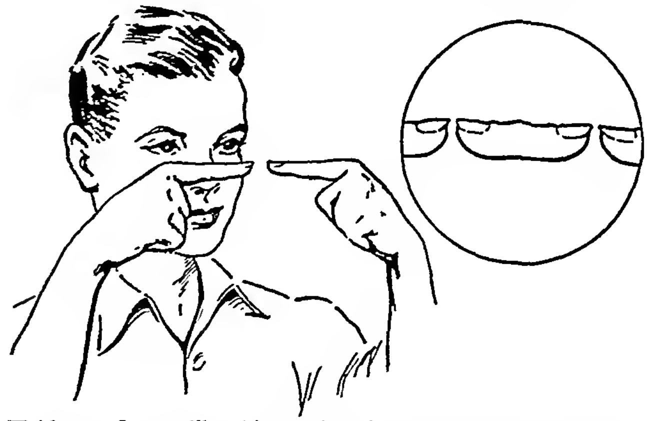
Each sensory experience leaves some sort of residue in the nervous system. This residue enables us to "relive" the experience in the absence of the original stimulus. Psychologists call this after-experience an *image* or an *idea.* The ability to have images or ideas adds a great deal to perception. A certain sound is at first nothing but a sound. Having experienced the sound in a visual setting, as when a mother's face is in view, one may recall her face when he hears the sound.

Feeling is also an aspect of perceiving. Certain stimuli arouse feelings of pleasure, displeasure, tension, calmness, or relaxation. The perceptual experiences associated with a visit to the dentist include recall of past dental experiences as well as displeasure and anxiety. Our aesthetic perceptions, as of a symphony or an art masterpiece, also include feelings as well as sensory experiences and memories.

The Different Senses

Each receptor, or sense organ, is sensitive to a special kind of stimulation. The eye is normally affected by light, but by no other kind of stimulation. The ear is attuned to sound waves and not to the chemical stimulation which gives rise to odors. Touch receptors respond to pressure, but not to light and sound waves.

AN ILLUSION OF DOUBLE IMAGERY



Hold your fingers like this boy is doing and stare above and beyond the tips. You will see the double image illustrated. Now close one eye and then the other. Each eye gets a different picture of the two fingers. When both eyes are used the different pictures overlap and produce an intervening double image.

Man is traditionally credited with having five senses, but we now know there are more. They include: *vision,* detected by light-sensitive cells in the inner layer of the eye, known as the retina; *hearing,* detected by minute hair cells of the inner ear; *smell,* detected through cells embedded in the mucous lining of the upper nasal cavities; *taste,* originating in onion-shaped buds below the surface of the tongue; *equilibrium,* or balance and bodily motion, detected by hairs stimulated by the movement of liquid in the canals of the inner ear; *touch, warmth, cold,* and *pain,* felt through special organs and nerve endings in and below the skin; *kinesthesis,* or muscle sensitivity, detected by receptors in the muscles, tendons, and joints; and *organic sensitivity,* detected by receptors in such organs as the stomach, intestines, and bladder. (*See also* Ear; Eye; Nose; Skin; Tongue; Touch.)

Sense organs vary in sensitivity. Organs of taste can respond to only four chemical substances—sweet, bitter, sour, and salty. The eyes are sensitive to more than half a million differences in stimuli.

Stimuli differ in intensity. A sound may be so low that it cannot be heard, a light so dim that it cannot be seen. A certain amount of stimulus is required to produce any sensitivity at all. A German psychologist, Gustav Theodor Fechner, called this the *law of the threshold.* Suppose you have one pail with enough sand inside to weigh 100 ounces and a second pail which weighs 101 ounces. You will be unable to determine which is the heavier. On the other hand, when you compare a 105-ounce pail with the one weighing 101 ounces, you will be able to distinguish a difference.

The intensity of a stimulus must be increased by a certain fraction of itself in order to produce a noticeably different sensation. A German physiol-

ogist, Ernst Heinrich Weber, stated the ratio, known as *Weber's law*, as follows: Light must be 1/100 more intense; a muscular sensation must be increased by 1/17; and feelings of pressure, warmth, and sound must be 1/3 stronger to be noticed by a normal person. Weber's principle is recognized as correct, although the exact ratios given by him have not always been verified in later research.

Perceptions of Space

We not only perceive objects as objects but we also see them in a world of space. A sheet of paper has two dimensions, height and width. But when you look at a box you know that it has the third dimension of depth in addition. You can also tell when one object is nearer than another. Several elements are involved in perception of depth and distance; the most important of these are:

1. When we look at objects at different distances, the lens in the eye changes its shape through the action of muscles within the eye. The eyes turn in toward the nose when we look at near objects, and they are parallel when the object is distant. The movement of these muscles helps us to judge how far away the object is.

2. In normal vision our eyes are focused so that the image of the object we are looking at falls on corresponding points on the two retinas, and a sense impression of a single object is produced. This is called *binocular vision*. When an object is too close, a double image is seen, as shown in the picture on the preceding page.

3. Because of the dust and moisture particles in the air, objects at a distance are not as distinct as those near by. When outlines are sharp and details clear, objects seem near. High in the Rocky Mountains, where the air is very clear, a mountain peak 40 to 50 miles distant seems only a few minutes' walk away. The clear outlines trick us into perceiving it as close by.

4. Suppose we look across the street at a house which has trees on the lawn and a car parked in front of the trees. The car covers from our view part of the tree trunks, and the trees conceal part of the house. We see the trees as nearer than the house they cut off from sight, and the car as nearer than the trees. This covering of parts of objects by others is a further aid in judging distance.

Seeing things right side up is partly inborn and partly learned. The human eye is like a camera. When we look at an object, its image on the retina is upside down with right and left reversed. Yet we see things right side up and in their correct right-left position. There is some evidence, from eye movements, that babies see right side up despite their upside down retinal image. Hearing and touch confirm what we see.

We have a tendency to see continuous movement even where there is no movement, as in electric signs. This is called *apparent motion*. On some electric signs a bulb is lighted, then an instant later another, then a third, and so on. The stream of lighted lamps appears to move in the direction of the new bulbs that are being lighted.

Ink Blots and Personality

Because memory, experience, and judgment enter into formation of perceptions from sensations, individuals will differ in the translations they make. The differences give useful clues to personality. Draw a square and then place in the center an irregular-shaped ink blot. Now look at the drawing. The small blot can be interpreted as something we know.

The ink-blot tests devised by Hermann Rorschach to test personality characteristics utilize this phenomenon. At first glance, the same blot will suggest different objects to people who see it. The various figures that a person sees in a carefully selected series of blots, when analyzed by a trained psychologist, provide clues concerning a person's attitude toward himself and others (*see* Imagination).

SENTENCE. A sentence is a group of words expressing a complete thought. We use sentences almost every hour of every day. A speaker or writer who makes a sentence must have something to think about. He must also single out some fact concerning it which interests him especially and assert that fact or ask a question about it. For example, suppose he is thinking about water. If he is going in bathing he may be interested in its temperature, and he asserts, "The water is cold." Or he may put his thought in the form of a question: "Is the water cold?" Under other circumstances he might think of the color and exclaim: "How blue the water is today!"

The part of the sentence that represents what is talked about is called the *subject*. All the rest of the sentence, which asserts, or *predicates*, something, is called the *predicate*. In all the sentences above, the words *the water* are the subject.

The complete subject of the sentence always contains a noun or a pronoun, or a group of words used like a noun, which stands for the thing talked about. This is called the *subject substantive*. It may or may not have adjuncts, or modifiers. In the sentence "People who live in glass houses mustn't throw stones," the word *people* is the subject substantive. It has a modifier, the clause *who live in glass houses*, showing which people are meant. The *complete* subject is the words "*people who live in glass houses*."

That Much-Needed Verb

The predicate of a sentence must always contain a verb (*see* Verb). Sometimes this verb by itself says all we want to say about the subject, as "The water *boils*." But often we want to add to the meaning of the verb, to make it clearer and more definite, as "Water *boils more rapidly if you make the fire hotter*." Certain verbs require other words to complete their meaning. Linking verbs, such as *be, become*, take a *predicate* noun, pronoun, or adjective to complete their meaning. Transitive verbs—those that express an action as affecting someone or something other than the subject—must have an *object*. This object may be one word or a group of words, as "The water burned *me*"; "He said *that the water was cold*."

Any or all of these necessary or essential elements of the sentence may be made more clear and interesting by the use of modifiers or adjuncts added to them; as, "The water *in the large kettle* is *not* boiling *yet, though the fire is hot*"; "The water *in our pond* is *still too cold for comfortable bathing.*"

These modifiers are either single words, phrases, or clauses. A *phrase* is a group of words not consisting of a subject and predicate, and used like an adjective, an adverb, or a noun; as, *under the tree, finding gold at the rainbow's end, to stay here.* A *clause* is a group of words consisting of a subject and predicate, combined with another such group to make a single sentence. For example, "I came, I saw, I conquered" is a sentence consisting of three clauses, each of which might stand by itself as a single complete sentence.

The Part the Clauses Play

Clauses which are of principal and equal importance in the sentence are called *coördinate* clauses. Clauses which are dependent on some other member of the sentence are called *subordinate.* Subordinate clauses may be used like adverbs, to define the meaning of the principal verb ("I shall come *when I am ready*"); like adjectives, to define the meaning of a noun or pronoun ("This is the house *that Jack built*"); or like nouns ("He told me *what I wanted to know*").

According to form, sentences are *simple, compound,* or *complex.* A *simple* sentence is a sentence that consists of one proposition. Either its subject or its predicate or both may be compound, as: "*Bread* (and) *potatoes* are starchy foods"; People *need certain food elements* (and) *usually enjoy the proper combinations of these*"; *Both men* (*and*) *animals require abundant fresh air* (and) *weaken in confinement.*"

A compound sentence is a sentence that consists of two or more independent propositions or clauses, as: "I came, I saw, I conquered." Propositions should not be joined in a compound sentence unless they are closely related in thought. "John is captain of our baseball team, and the North Pole has been discovered," though from one point of view correct grammatically, is not a real sentence, since it is not the expression of a single thought. The members or parts composing a compound sentence are usually joined by a coördinating word called a conjunction (*see* Conjunction).

A *complex* sentence is a sentence consisting of a main proposition or clause and one or more subordinate clauses; as, "Wait *till he comes.*" "Between the dark and the daylight, *when the night is beginning to lower*, comes a pause in the day's occupations, *which is known as the children's hour.*"

Now in nearly all the sentences we have talked about so far, the predicate states or *declares* something about the subject. For that reason we call such sentences *declarative* sentences. But there are also three other kinds of sentences, distinguished according to meaning. There is the kind that asks a question; as, "Is Buenos Aires the largest city of South America?" These question-asking sentences are called *interrogative* and always end with a question mark (?). Another kind of sentence commands someone to do something; as "Everybody come in!" We call this sort of sentence *imperative,* and often put an exclamation point (!) after it. Then there is a fourth kind of sentence that we use when we want to express strong feeling about something. For example, if you are surprised to wake up in the morning and see a heavy fall of snow you exclaim, "What a lot of snow has fallen!" Such a sentence is called *exclamatory,* and always has an exclamation point after it.

Some very common mistakes in writing are due to vague notions about the difference between a sentence and a clause or phrase. Two or more separate sentences are often incorrectly written as if they were one sentence; as, "The trees by the pond are bare now, they are maples and willows." And, on the other hand, uneducated persons will sometimes treat a part of a sentence as if it were a sentence by itself; as, "He was well satisfied with the returns in health and good fellowship. Though he lost money by the undertaking."

SEPTEMBER. The name of this month comes from the Latin word meaning seven, and it was the seventh month of the Roman calendar (beginning with March). September is the ninth month according to our reckoning. It has always had 30 days. It is preëminently the harvest month, and in it occurs the autumnal equinox (*see* Equinox and Solstice).

SEQUOI'A. Among the largest and oldest of all forest trees are the towering sequoias. Some of them were 2,000 years old when Christ was born. They grow to be several hundred feet high and the trunks may be more than 30 feet thick at the base. One tree (named Wawona) in Yosemite National Park has a passage for motor busses cut through its base. (For picture in color of a sequoia, *see* National Parks.)

The name "sequoia" was given these trees in honor of Chief Sequoyah, a Cherokee Indian who invented an alphabet for his language in 1821. Botanists use the word in the scientific names for three different kinds of trees. But only one kind is called sequoia as a common name. Other common names for this species are giant sequoia and bigtree. The other two are called the redwood and the dawn-redwood.

All three trees are cone bearers. The first two are also evergreens and grow only on the Pacific coast of the United States. The dawn-redwood sheds its leaves in winter. It is a native of China.

The Sequoias of the Mountain Slopes

Sequoias, or bigtrees, grow only in California, on the western slopes of the Sierra Nevada. They stand at elevations of from 5,000 to 8,000 feet above sea level. Most of them are in a few scattered groves in Sequoia, Yosemite, and King's Canyon national parks. There they are protected from lumbering.

The trunk of a sequoia may rise 100 feet without a branch. Above this height the tree grows a narrow

crown of branches and leaves. The leaves are small, narrow blades, growing along the sides of branchlets. The cones are small and bear remarkably small seeds. It takes about 48,000 seeds to weigh a pound. The seeds contain a dark-red pigment which is rich in tannin. In water, the pigment makes a nonfading ink.

The bark is a bright cinnamon color, deeply ridged, and one to two feet thick. The heavy bark resists forest fires and the attacks of insects and blights. Even fallen trees do not decay for hundreds of years.

It has been thought that the bigtrees are dying out because few if any seedlings are found in the groves. But the trees fail to establish seedlings only because the surrounding ground is so thickly littered that the seeds cannot take root, and sunlight is insufficient. If the seeds are given room, sunlight, and a bare, moist soil, they produce strong young trees.

Some Famous Bigtrees

Sequoias reach a height of from 250 to nearly 300 feet. The diameter at the base is from 10 to 35 feet.

The General Sherman tree, preserved in Sequoia National Park, is 272.4 feet high and 36.5 feet in diameter at its base. A man could lie crosswise on one of its branches, 7 feet in diameter. The main trunk would furnish more than a half-million board feet of lumber, enough to build 40 five-room houses. The Grizzly Giant, in Mariposa Grove, Yosemite National Park, is 209 feet high. Its diameter at the base is 27.6 feet and its girth 96.5 feet. It is believed to be 3,800 years old. The Clothespin tree in the same grove is 293 feet high. Within the fallen trunk of another tree in the Calaveras Grove near Stockton is a passage big enough for a man on horseback.

LOOKING UP A SEQUOIA TRUNK

This unusual view of a forest giant in Sequoia National Park shows the tremendous height of the tree. The leafy crown seems almost in the sky. The folds in the bark may be a foot or more deep.

Redwoods of the Pacific Coast

The redwoods grow in the "fog belt" of the Coast Range on the Pacific Ocean side of the mountains from southwestern Oregon to Santa Barbara County. They reach even greater heights than the sequoias. Accurate measurements are hard to obtain, but one tree is known to be 364 feet high with a diameter of 12 feet 7 inches at the base. The Muir Woods National Monument, near San Francisco, preserves one of the largest and most beautiful groves. Many others are in state parks. They do not live as long as sequoias. Few redwoods are more than 1,000 years old.

The reddish-brown bark of the redwood is 4 to 12 inches thick. Redwoods differ from sequoias and other evergreens which reproduce from seed by producing vigorous stump sprouts. These reach tree size quickly. On many redwood trees there are round, wartlike burls, formed probably by closely crowded buds which continue to grow but rarely send out shoots. These burls have a handsome bird's-eye grain and are used commercially for veneers and for souvenir articles.

Redwood lumber is light, straight-grained, and easily worked. When correctly dried it does not shrink or warp. It burns very slowly, for it contains no resin. It resists insects and decay almost indefinitely. Hence it is used for fence posts, telegraph poles, railway ties, paving blocks, bridges, piers, tanks, and water-supply conduits. In housebuilding, redwood is used for foundations, siding, shingles, and trim.

Dawn-Redwood of China

A third species of the sequoia group has been known for many years from fossil specimens, but botanists thought it had died out millions of years ago. In 1945, however, living specimens were discovered in Szechwan Province in China. The tree was called the dawn-redwood because it was known for so long only as a fossil. It resembles the bald cypress, and like the cypress it loses its leaves in the fall. Attempts are being made to grow it from seed in California.

The sequoia group belongs to the family *Taxodiaceae*, together with the bald cypress. Scientific name of the giant sequoia or bigtree, *Sequoia gigantea*, or *Sequoia washingtoniana;* redwood, *Sequoia sempervirens;* dawn-redwood, *Metasequoia glyptostroboides*.

SERBIA. In the 14th century Serbia ruled the greater part of the Balkan peninsula from the Danube to the Gulf of Corinth. A century later it was conquered by the Turks, and Serbs were sold as slaves in the markets of Constantinople.

In the 19th century Serbia was freed from Turkish rule and grew in economic and political strength. The Balkan Wars of 1912–13 almost doubled the national territory. The first war was fought against Turkey and the second against Bulgaria, an ally in the first war. The Serbs dreamed of restoring the "Greater Serbia" of their golden age; but up to the outbreak of the first World War, Serbia remained a peasant kingdom of small farmers. Though ravaged by Austrians and Bulgarians in the war, the Serbians held out courageously to the end. They were rewarded by the reunion of the whole South Slav race in the "kingdom of the Serbs, Croats, and Slovenes." The new nation was named Yugoslavia. (*See* Yugoslavia.)

An inland kingdom, old Serbia extended southward from the broad plain of the Danube River into the long valley of its tributary, the Morava. On the east, west, and south it was hemmed in by mountains; but along its northern frontier ran the chief route from central Europe to the southeast. Here on the Danube rose Belgrade, the capital, which later became the capital of Yugoslavia (*see* Belgrade). After the Balkan Wars the country covered an area of 36,940 square miles and had a population of about 4,150,000.

How the Serbs Built Up Their Kingdom

The Serb tribes first appeared in the Morava valley in the 7th century, during the long period of Slavic migration into the Balkans (*see* Balkan Peninsula). Their social structure was founded on blood ties. The unit was the *zadruga,* a large family group, the members of which lived together and owned their farms and pastures in common. Several zadrugas, more or less related to one another, formed a tribe, ruled by a *zhupan.* For protection a number of tribes usually banded together under a "grand zhupan." These large clans engaged in bloody civil wars, striving for supremacy.

In the 9th century, when the Bulgarians were pressing on their borders, the zhupans bowed to the authority of the Byzantine Empire and the Serbs embraced Christianity, joining the Greek Orthodox Church (*see* Byzantine Empire). In the 11th century they revolted against Byzantium and formed the first Serb kingdom. Gaining strength under a series of able rulers, they reached the peak of their power under Stephen Dushan the Great (1331–55). He wrested large territories from the Byzantine Empire, which was crumbling under the blows of the Turks, and proclaimed himself czar of the Serbs and Greeks.

The nation fell apart after Stephen's death; and in 1389 the Turks inflicted a crushing defeat on the Serbs in the battle of Kosovo. The sultan of Turkey and the last of the Serb czars both perished on this fatal "Field of the Blackbirds," which is celebrated in Serbian folklore and ballads. For four centuries the Serbs suffered under the cruel Turkish rule. The aristocracy was wiped out, the peasants mercilessly taxed, and their sons taken from them to serve with the Turkish Janizaries.

Serbia Throws Off the Turkish Yoke

In 1804 the Serbs rose under the peasant leader George Petrovitch (called Kara-George or Black George) and recovered the district about Belgrade. In 1813 Kara-George was forced into flight, and Milosh Obrenovitch took over. In 1817 Serbia emerged practically independent, though still nominally a principality of Turkey. When Kara-George returned, Milosh had him murdered. A long feud then began between the two families, who ruled alternately in swift succession, their reigns ending usually with forced abdication or assassination. In 1903 the last Obrenovitch, King Alexander, was murdered in his palace with his Queen, Draga; and Peter I, of the Kara-George dynasty, took possession of the throne.

Following the Russo-Turkish War, the Congress of Berlin (1878) conferred complete independence on Serbia. Soon Serbia began to dream of rebuilding her short-lived empire. In 1912 she joined in the first Balkan War on Turkey and almost doubled her territory. In the second Balkan War (1913) she successfully defended her gains against Bulgaria, her former ally (*see* Balkan Peninsula).

Serbia had long coveted the Turkish provinces of Bosnia and Herzegovina, and bitter feeling was stirred up when Austria-Hungary annexed them in 1908 (*see* Austria-Hungary; Bosnia and Herzegovina). Tension reached a climax in June 1914 when Serb conspirators assassinated the Archduke Francis Ferdinand, heir to the Austrian throne. On July 28 Austria-Hungary declared war on Serbia and the first World War began (*see* World War, First). At the end of the war Serbia merged with the former Austro-Hungarian provinces along the Adriatic Sea to form the kingdom of the Serbs, Croats, and Slovenes, which in 1929 became the kingdom of Yugoslavia. After the second World War, Serbia became one of the six republics that make up the Federal People's Republic of Yugoslavia. (*See also* Yugoslavia.)

BLOOD SERUM *from* ANIMALS *Used as* MEDICINE

SERUM THERAPY. In 1890 a young German doctor, Emil von Behring, resolved to find a cure for diphtheria. This disease was taking a tremendous toll among young children in Berlin, as in other cities of Europe and America. The germs that caused the disease had been identified as rod-shaped bacilli. Bacteriologists had proved that a poison made by the germs did more damage than the germs themselves. But no one had found a successful way to treat the disease. Half the children who got diphtheria died.

Von Behring hoped to find a drug that would kill diphtheria germs in the bodies of sick children without hurting the children. For a year or more he injected guinea pigs with cultures of diphtheria bacilli and liquid poison, or toxin, filtered off from the cultures. In this way he made the animals come down with diphtheria so that he could try to cure them. He finally found a drug—iodine trichloride—that cured a few of the guinea pigs, but it made children with diphtheria even sicker.

Then von Behring learned that the animals he had cured of diphtheria did not get the disease again even when he injected large doses of germs or toxin into them. They were *immune*—protected against the disease. And if he injected blood serum from an immune animal into one that had not had diphtheria, it too became immune. But the protection did not last more than two or three weeks. If it could be produced in children it would not do them much good.

The young doctor decided to try serum from immune animals to treat instead of to prevent diphtheria. He used sheep now, instead of guinea pigs, because

he could take more blood from the larger animals. By injecting germs, toxin, and iodine trichloride, he finally made a few sheep immune. He injected some of their serum into guinea pigs that were desperately sick with diphtheria. They recovered. Late in 1891 he began to give serum injections to children with diphtheria. Most of them got well. He had found a cure for diphtheria after all.

News of the discovery spread fast. Doctors called the new medicine *antitoxin* because it worked against a toxin. Soon German drug manufacturers were producing antitoxin on a large scale. The New York City Health Department began to make it in 1894. The diphtheria death rate fell from 50 to 26 per cent.

A Cure for Infectious Diseases?

Treatment of disease with serum from an immune animal (called immune serum) received the name *serum therapy*. Hope ran high that the new method could be used to cure other diseases caused by germs.

The horse succeeded the sheep as the favorite animal for producing serum. Research disclosed better ways of creating immunity than Von Behring had used in his work with diphtheria. Giving a very small dose of germs or toxin in the first injection and gradually increasing the amount in succeeding injections often produced immunity without causing a fatal attack of the disease. In time scientists learned that even toxin neutralized with antitoxin or with a strong chemical would produce immunity. So would bacteria killed with heat or chemicals.

The Types of Immunity

Research gradually brought a better understanding of immunity. Scientists learned that when germs invade the body certain tissues respond by forming germ-fighting antibodies (*see* Disease). Many of these remain in the blood after recovery and ward off attack by the same kind of germs. They are the source of immunity. The protection that follows disease or vaccination is called *active immunity* because the body made its own germ fighters (*see* Vaccination).

Injection of blood serum from an immune animal introduces ready-made antibodies into the system. In a well person they produce *passive immunity*. This does not last long because the body soon throws off the "foreign" antibodies. In a sick person, the ready-made antibodies help those the patient's own system is making. The reinforcements may turn the tide of battle between antibodies and germs.

Serums from Animals and Human Beings

The serums developed were of two types. Some were antitoxins, like diphtheria serum (*see* Antitoxin). Others were antibacterial serums. These came from animals that had been immunized with bacteria, and they attacked bacteria rather than toxins. Some antibacterial serums were made from the blood of human beings who had recovered from an infectious disease. They were often called convalescent serums, because the blood was taken during convalescence, when antibodies are especially numerous. The antibacterial group included serums to treat pneumonia, meningitis, scarlet fever, measles, erysipelas, and whooping cough.

The antitoxins have proved to be the most successful. Antibacterial serums are uncertain in their action. One reason is that a species of bacteria which causes a disease may have many strains. Serum that contains antibodies formed to fight one strain is not effective against another strain.

Von Behring Made Medical History

The hope that serum therapy would provide a cure for most infectious diseases was not realized. Immunity to some diseases could not be established in animals. Some immune serums had little effect on the disease they were meant to cure. Animal serum, coming from a different species, sometimes made human patients sick (*see* Allergy). Sulfa drugs, penicillin, and other antibiotics—drugs such as Von Behring had dreamed of—proved more effective than many of the serums (*see* Antiseptics).

Nevertheless, Von Behring's work is a landmark in the history of medicine. Diphtheria antitoxin was the first specific remedy found for an infectious disease; that is, the first remedy that acted directly on the cause of the disease. And his work increased immeasurably our knowledge of immunity.

The "SEVEN WONDERS" *of* ANTIQUITY *and of* TODAY

SEVEN WONDERS OF THE WORLD. Guidebooks for travelers in the time of Alexander the Great often named seven great works of man as most worthy to be seen in a tour of the world. These lists of "seven wonders" of the ancient world varied somewhat, but the following tabulation (given in a treatise of about the 6th century A.D.) was a standard one: (1) the pyramids of Egypt; (2) the Hanging Gardens of Babylon; (3) the statue of Zeus at Olympia; (4) the Mausoleum at Halicarnassus; (5) the temple of Artemis (Diana) at Ephesus; (6) the Colossus at Rhodes; and (7) the Pharos (lighthouse) at Alexandria.

The massive pyramids of Egypt still stand on the edge of the desert overlooking the valley of the Nile. Built between 2650 and 2500 B.C., the pyramids have long been regarded as one of the greatest architectural achievements of mankind. Except for fragments of the Mausoleum and of the temple of Artemis, they are the only one of the seven wonders remaining today (*see* Pyramids).

The Hanging Gardens of Babylon have long since disappeared. They were said to have been built by King Nebuchadnezzar (in the 6th century B.C.) to please his favorite wife, who had come from a hilly land and wearied of the plains of Babylon. Great terraces of masonry were built one on top of the other. On these were planted gardens of tropical flowers and trees and avenues of palms, irrigated by water pumped from the Euphrates River. There Nebuchadnezzar and his queen could sit in the cool shade and look down upon the beauties of the city. The walls of Babylon were often included with the Hanging Gardens

THE PYRAMIDS OF EGYPT

Of the seven wonders of the ancient world, the pyramids of Egypt alone have survived in any sort of completeness. The Great Pyramid (center) has lost all its polished granite facing, however, and only a little of the Second Pyramid's facing remains.

among the wonders of Babylon. Built by Nebuchadnezzar, they were faced with glazed tile and pierced by openings fitted with magnificent brass gates.

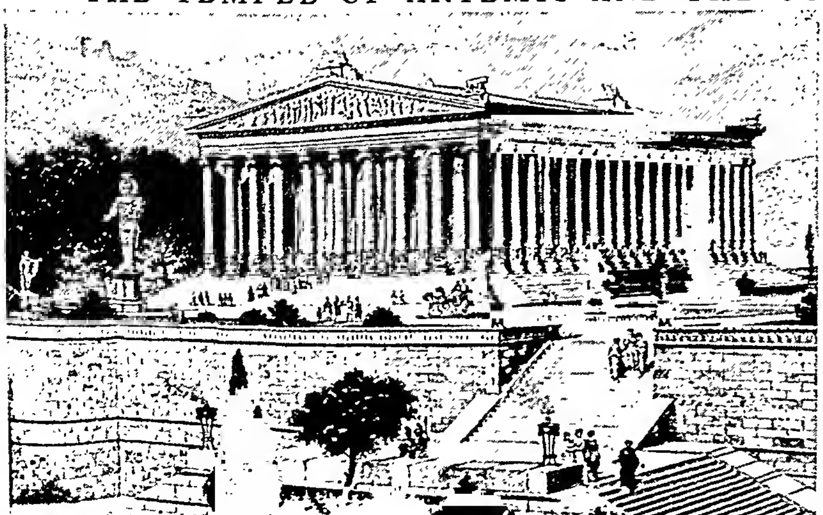
The statue of Olympian Zeus was erected at Olympia, in the Peloponnesus of Greece, by the great sculptor Phidias in the 5th century B.C. It was a towering structure of ivory and gold, 40 feet high, majestic and beautiful. After about 10 centuries of existence the statue was destroyed and our only idea of it is gained from coins of Elis, which are thought to bear copies of the original (*see* Phidias; Zeus).

Greek colonists at Ephesus, in Asia Minor, built the famous temple of Artemis. The early settlers found the Asiatic inhabitants worshiping a many-breasted nature goddess whom they identified with their Artemis (called Diana by the Romans). They raised a shrine to her, which was rebuilt and enlarged from time to time. The fourth temple was the one regarded as the wonder of the world. Dedicated about 430 B.C., it is said to have been built by contributions from all the great cities of Asia and to have taken 120 years to complete. This great temple was set on fire in 356 B.C. on the night Alexander the Great was born, according to tradition. The crime was committed by one Herostratus merely that his name might be remembered in after ages.

The Mausoleum at Halicarnassus, also in Asia Minor, derived its name from King Mausolus of Caria. After his death in the middle of the 4th century B.C., his queen, Artemisia, employed Greek architects to construct a superb monument over his remains. It was a great rectangular pile of masonry, surmounted by an Ionic colonnade supporting a rooflike pyramid. At the apex stood a four-horse chariot in which were statues of the king and queen. So famous was this structure that the word mausoleum came to be applied to any monumental tomb. Some relics of the original Mausoleum are preserved in the British Museum.

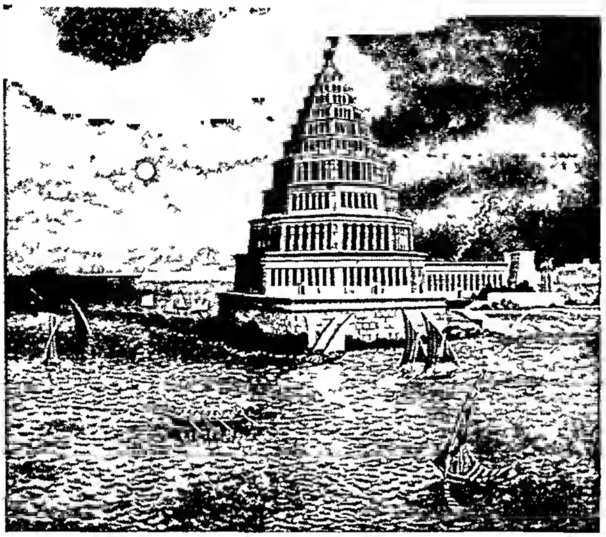
The Colossus of Rhodes was a great bronze statue, erected about 280 B.C. by the citizens of Rhodes, capital of the Greek island of the same name. It represented their sun-god Helios and was said to be 105 feet high. According to legend, it straddled the harbor entrance, but it is more likely that it stood to one side. The statue was overthrown by an earthquake in 224 B.C. but its huge fragments long were regarded with wonder. Nearly a thousand years later, in A.D. 656, a Moslem dealer bought the fragments as old metal and carried them away to be melted down.

THE TEMPLE OF ARTEMIS AND THE COLOSSUS OF RHODES

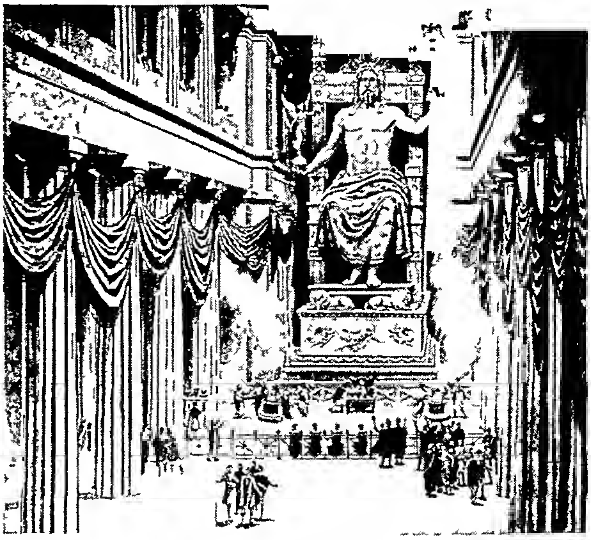


Very little of the temple of Artemis (Diana) at Ephesus remains today and the Colossus of Rhodes has completely disappeared. The drawing at the left shows the huge temple as it probably looked in the 4th century B.C. The old engraving of the Colossus of Rhodes at the right is purely imaginary and is based on the legend that the statue stood astride the harbor entrance.

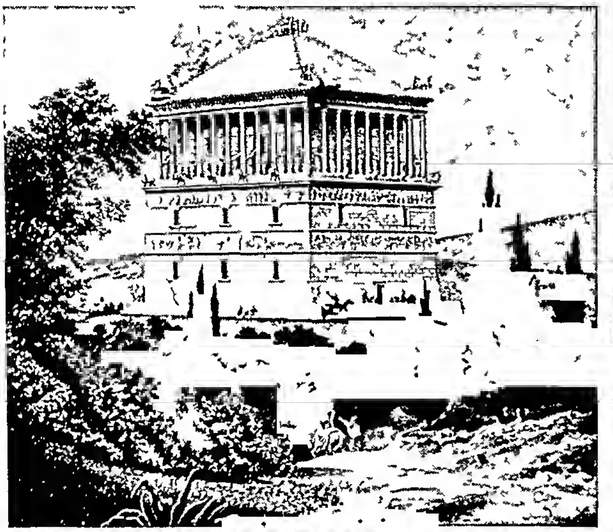
FOUR MARVELS OF ARCHITECTURE AND SCULPTURE



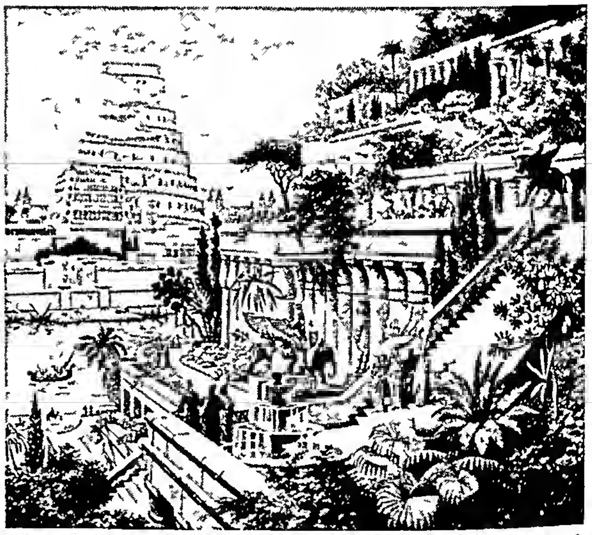
For more than a thousand years the Pharos of Alexandria guided Mediterranean ships to harbor. Severely damaged by an earthquake in A.D. 955, it had disappeared completely by 1500.



The ivory and gold statue of the Olympian Zeus was perhaps the greatest masterpiece of the sculptor Phidias. It stood in a shrine on the Olympian plain until the early Middle Ages.



Only crumbling fragments remain of the Mausoleum at Halicarnassus on the coast of Asia Minor. It was raised to the memory of King Mausolus of Caria by his devoted queen, Artemisia.



According to tradition, the homesickness of a favorite wife prompted Nebuchadnezzar, king of Babylon, to build the famous Hanging Gardens. Nothing remains of these luxuriant terraces

The Pharos of Alexandria, in Egypt, was the forerunner of modern lighthouses. The name belonged originally to an island lying off the coast. When Alexander the Great laid out the city he connected the island of Pharos with the mainland by means of a mole, or causeway. On the eastern point of the island his successors, Ptolemy I and Ptolemy II, erected a great lighthouse of white marble. It was this structure, said to have been 400 feet high, that came to be known as the Pharos of Alexandria.

Modern Wonders

To ancient and medieval people the number seven had a mystical significance. Accordingly they were much given to compiling lists involving this number—the seven wonders, the seven champions of Christendom, the seven seas, and so on. Some of this significance still clings to the number seven, and people continue the harmless pastime of compiling lists of the seven wonders of the world.

The wonders of the modern world lie not so much in the fields of architecture and sculpture as they do in technology. A list of seven modern wonders compiled after the first World War attracted some notice. It included: (1) radio; (2) the telephone; (3) the airplane; (4) radium; (5) anesthetics and antitoxins; (6) spectrum analysis; and (7) X rays. The list seems deficient in that it fails to include the automobile, which revolutionized ways of living in the United States, and the techniques of mass production, which made modern industry possible. Anyone making such a list today would undoubtedly also include atomic energy and television as modern wonders.

SEVEN YEARS' WAR (1756–1763). When Frederick the Great of Prussia, in 1740, seized the Austrian province of Silesia, he, like the youth who murdered the Austrian archduke at Sarajevo in 1914, set off a powder mine that had been laid by the world-wide rivalries of European powers and alliances. The struggle spread from Austria and Prussia to all Europe, and finally burst over the whole world from the Indian rajahs of Hindustan to the European colonists of Canada and New England. For more than a score of years the quarrel disturbed the peace of Europe. In the War of the Austrian Succession (1740–1748)—called by Germans the first two "Silesian" wars—Maria Theresa, the courageous young ruler of Austria, made two vain attempts to recover her stolen lands (*see* Maria Theresa). There was next a breathing spell of eight years. Then in 1756, having won new support among the powers of Europe, she decided to try a third time; but before she and her allies could strike a blow, Frederick the Great, learning of their intentions, invaded the neutral but unfriendly land of Saxony, and so himself began the third Silesian or Seven Years' War.

Since the beginning of the quarrel over Silesia there had been a general shift in the relations of the nations of Europe. In the War of the Austrian Succession Great Britain had taken up arms on the side of Austria, while France had fought alongside Prussia. But when the conflict began in 1756 a "diplomatic revolution" had brought a reversal of alliances. With Prussia was now allied its former enemy, Great Britain, where William Pitt, the Elder, was now in control (*see* Chatham, Earl of). Pitt saw more clearly than did the stupid George II that the second "hundred years' war" between France and England for colonies must be won in Europe. Kaunitz, a young minister of Maria Theresa, also looked at old questions with new eyes. He persuaded her to forget the old French (Bourbon) and Austrian (Hapsburg) rivalry extending over 250 years, and to seek aid in France against her real enemy, the rising power of Prussia. France—or rather Madame Pompadour, Louis XV's favorite—listened, hesitated, and then joined Austria.

The League of the Three Petticoats

On the one side there were Austria, Russia, and France—"the League of Three Petticoats" (Madame Pompadour, Maria Theresa, and Empress Elizabeth of Russia), as it was sneeringly called. On the other were Great Britain with its navy and Prussia with its well prepared army, plus Pitt's statesmanship and Frederick's military genius.

At the outbreak of the war Frederick made himself master of Saxony by the defeat of the Austrians, temporarily invaded Bohemia, and again inflicted defeat upon the Austrians (at Prague, May 1757). Later in the year he defeated the French and his German enemies in the most famous, perhaps, of his battles—at Rossbach. A month later (December 1757) he routed the Austrians at Leuthen. Through the varying fortunes of the two succeeding years, Frederick's military genius enabled him, despite desperate situations when he was ringed about by hostile Russian, French, Swedish, and Austrian armies on Prussian soil, with Berlin occupied and plundered, to wrest victories from his enemies and hold the balance even in Europe, while Pitt directed the forces of England to triumph in America and India. Then George III came to the English throne, in 1760. The genius of Pitt made him uncomfortable. The great minister was forced to resign in 1761, and shortly afterward the money subsidies which England had been paying to Frederick ceased. Frederick's straits were somewhat relieved in the following year, when Elizabeth of Russia died and Peter III, her successor, in his few months' reign made peace with Prussia. Sweden and France fell away from the alliance, and finally Austria, too weak to carry on the war alone, made peace with Prussia at Hubertsburg (Feb. 15, 1763). The map of Europe was not changed by this peace, for Silesia was confirmed as a possession of Frederick.

A War on Three Continents

The war, as has been said, was not confined to Europe. In America the conflict had begun the year before it broke out in Europe, and was known as the French and Indian War (*see* French and Indian War). Here the struggle went against France, and in the end she lost all of her American possessions.

In India English prowess met with like good fortune. The East India Company had founded settlements for trade, which gave promise of extending to an empire; but France, jealous of her hereditary rival, endeavored to snatch the prize. Dupleix, the able French governor of Pondicherry, captured Madras, and by intriguing with the native princes attempted to make French power supreme over the country. In this ambitious scheme he was checkmated by the stupidity of the corrupt French court, which sent him no support, and by the genius of Robert Clive, who from a clerkship in the East India Company rose to be one of the greatest of English generals and the founder of British rule in India (*see* Clive, Robert). The prolonged and desperate struggle in America and in India ended by the Peace of Paris, a few days before the treaty which closed the conflict in Europe (Feb. 10, 1763). France ceded to Great Britain the whole of Canada, together with various islands in the West Indies. The captured French trading stations in India were restored but were not to be fortified. Spain, which had been drawn into the war on the side of France, ceded Florida to England (which held it until 1783), while France compensated Spain with the cession of the Louisiana country west of the Mississippi.

It is not too much to say that the Seven Years' War was a turning point in the world's history. Prussia emerged triumphant and stamped with the military prestige and doubtful diplomacy of Frederick. The Prussian-Austrian struggle for leadership

of the German states was launched. France had lost most of its colonies and much of its prestige and was approaching the great French Revolution. Britain had acquired a world empire "on which the sun never set." The 13 American Colonies, however, had a new idea of their place and power in the British Empire. Their political and economic grievances against Britain already pointed to a future clash with the mother country in the American Revolution.

SEVIER (*sē-vēr'*), JOHN (1745–1815). Whenever slim, bold John Sevier sighted Cherokee Indian raiders in Tennessee, he shouted his own war cry to his frontiersmen—"Here they are! Come on, boys, come on!" In 35 battles in 20 years Sevier led his backwoods riflemen to 35 victories. As frontiersman, Indian fighter, and statesman, Sevier protected the little wilderness settlements in eastern Tennessee and guided the state in its early development.

Sevier was born Sept. 23, 1745, in the Shenandoah Valley of Virginia, the eldest of seven children. His father, Valentine, had come there from England; but the Seviers traced their ancestry to a French Huguenot family named Xavier. Young John had some schooling, at Fredericksburg and Staunton, then quit to clerk in his father's fur-trading business. At 16 John married and began to farm and to trade throughout the valley. When only 19, Sevier founded New Market, Va., and became a noted Indian fighter.

In 1772 he moved his family beyond the Alleghenies to the Watauga settlements (*see* Tennessee). His bravery and organizing skill soon made him their leader. In 1774 he served as a captain in "Lord Dunmore's War." He moved in 1778 to the Nolichucky River. His leadership there won him the nickname of "Nolichucky Jack."

Kings Mountain Battle

By 1780 the British forces in the Revolution were marching westward to seize the wilderness settlements. Sevier (then a colonel in the militia), with a few other frontier officers, led about 1,000 mounted frontier riflemen to throw back the redcoats. On Oct. 7, 1780, they repeatedly charged the British stronghold on Kings Mountain, S. C., and captured it. This victory has been called a "turning point of the Revolution." In 1781 Sevier aided Francis Marion and later became a brigadier general in the militia.

IN OLD SEVILLE

Shaggy burros carry most of the loads in old Seville. These tiled houses with thick walls built to keep out the heat show Moorish influence.

In 1784 the border settlements were rejected by North Carolina. They created a separate state of Franklin (or Frankland) and elected Sevier their first and only governor. Franklin collapsed in 1788. Sevier was imprisoned by North Carolina authorities, but he escaped. He was then allowed to serve in the North Carolina senate, and in 1790 he was sent to Congress. When Tennessee became a state, he was elected its first governor, 1796–1801, and again in 1803–9. In 1811 he again was sent to Congress. He died in 1815 in Alabama while surveying boundaries of Creek Indian lands ceded to the government. A monument to him stands in Knoxville, Tenn.

SÉVIGNÉ (*sā-vē-nyā'*), MADAME DE (1626–1696). Beautiful, witty, warm-hearted Madame de Sévigné has been called "queen of letter writers." She was born in Paris, Feb. 5, 1626, as Marie de Rabutin-Chantal. At seven years of age she was orphaned. When she was ten she became the ward of her uncle, the Abbé de Livry, who gave her an excellent education in the classics, languages, and the literature of the day.

At 18 she married a handsome young wastrel, Henri, the Marquis de Sévigné. In 1651 he was killed in a duel, leaving her with a daughter, Françoise Marguerite, and a son, Charles. They grew up to be weak, selfish, and snobbish; but Madame de Sévigné lavished affection and wealth on them. She was a member of the most aristocratic and intellectual salons, and her especial friends included La Rochefoucauld.

Françoise married the Comte de Grignan in 1668 and moved to Provence. Madame de Sévigné was torn by loneliness. She wrote Françoise almost daily. The letters are filled with bright, sharp details, giving a better insight into the life of the times than many formal history books. The correspondence covers 25 years, until Madame joined Françoise in Provence.

SEVILLE (*sĕ-vĭl'*), SPAIN. The beauty of sunny Seville, fourth largest city of Spain, delights tourists. Roses bloom the year around; Moorish fountains tinkle coolly in patios and plazas; gardens are green and fragrant with vines, palms, and olive and orange trees.

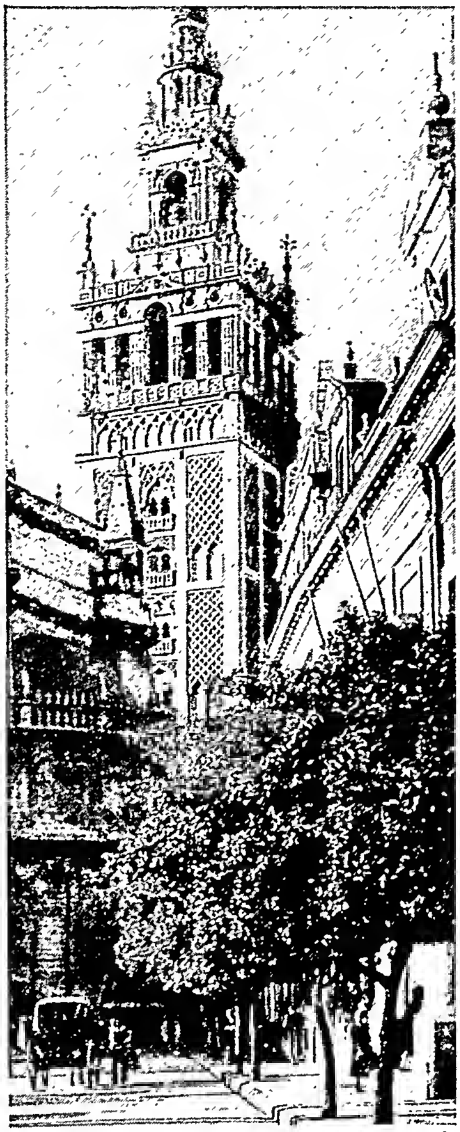
Seville (*Sevilla* in Spanish) stands along the Guadalquivir River, about 55 miles from the mouth, in the fertile lowlands of the Andalusian region in southwestern Spain. It is often called the "Pearl of Andalusia."

Much of Seville is modern; but the old quarters have changed little since Moorish days. From the whitewashed houses balconies overhang the narrow twisting streets. On fete days costumed dancers swirl to the click of castanets. Four noted operas have sought to catch the gaiety and color: Rossini's 'Barber of Seville', Bizet's 'Carmen', Mozart's 'Marriage of Figaro' and 'Don Giovanni'.

Seville is proud of its great Alcazar, built by the Moors; its vast Gothic cathedral; and the Giralda, once a minaret and now a "golden-voiced" bell tower. Throughout the city are paintings by Murillo, who, like Velasquez, was born in Seville. In Seville's archives are autographs of Pizarro, Cortes, Magellan, and Americus Vespucius; and a letter signed by Cervantes, applying for a position in America. Seville believes that the remains of Columbus rest in its cathedral; but the Dominican Republic also claims this historic honor, asserting that the remains in Seville are those of his son, Diego.

Even in Roman times Seville was an important port. The Vandals seized it in the 5th century, the Visigoths in the 6th century; then, in 712, the Moors captured it. They held it till Ferdinand III of Castile freed it in 1248. Today it is Spain's chief port, shipping ores, wine, oranges, olives, and oils. Its chief manufactures include tobacco, pottery, chocolate, cork, iron, and silk. Population (1950 census), 376,627, including suburbs.

SEVILLE'S BELL TOWER



The Giralda rises at the corner of the Gothic cathedral. The delicate tracery is Moorish work. Note the sharp light and shadows of Seville's famous sunlight.

SEWARD (*sū'ẽrd*), **WILLIAM HENRY** (1801–1872). In the spring of 1860 William Henry Seward, recognized leader of the Republicans, left his seat in the United States Senate and went home to Auburn, N. Y., to await the expected news of his nomination for the presidency by the national Republican convention in session at Chicago. To his amazement the nomination was given to Abraham Lincoln, whose name was scarcely known outside of his own state of Illinois.

Seward's surprise was natural, for he had been a brilliant lawyer and a leading figure in New York and national politics for 30 years. He was graduated from Union College at the age of 19 and was admitted to the bar two years later. He was a master politician and had a ready gift of flowery eloquence. Once, when Lincoln and Seward were on a trip together, and a crowd was calling for a speech, Lincoln turned to Seward, saying, "Seward, you go out and repeat some of your *poetry* to the people."

Seward had served as New York state senator (1830–34), as governor of that state (1839–43), and for 12 years as United States senator (1849–61). He had long been conspicuous as a foe of slavery, and in 1850 he had created a sensation by a speech in the Senate when he had declared: "The Constitution devotes the Domain [i.e., the territories] to liberty. But there is a *higher law* than the Constitution which devotes it to the same noble purpose." In 1858 he declared that there was an "irrepressible conflict" between the principles of slavery and freedom, and that the nation must become either all slave territory or all free.

He Accepts Lincoln's Leadership

In consideration of his experience and ability it is no wonder that Seward was deeply disappointed when Lincoln was the one who received the Republican nomination. Nevertheless he hid his chagrin and accepted the position of secretary of state in Lincoln's Cabinet. At first he felt, as did most of the country, that he would be the power behind the throne and that the president would be a mere figurehead. Soon after Lincoln took office Seward wrote to his wife: "If I am absent only three days, this administration, the Congress, and the District would fall into consternation and despair." In a short time, however, Lincoln had tactfully but unmistakably demonstrated that *he* was the head of the government. Seward's opinion of Lincoln's qualities became so changed that in a later letter to his wife he said: "Executive skill and vigor are rare qualities. The President is the best of us."

During the war Seward had a wide field in which to display his patriotic abilities, and he rendered invaluable service. In spite of the difficulties with England (*see* 'Alabama' Claims; 'Trent' Affair) he managed relations with that country and with France so that neither recognized the independence of the Confederate States, although each had at times seemed inclined to do so.

So prominent a part did Seward play in the administration that on the night that an assassin's bullet struck down Lincoln, an attempt was made on Seward's life also. The wound did not prove fatal, and for four years more Seward carried the heavy burden of the office of the secretary of state, under Lincoln's successor, President Andrew Johnson. His greatest achievement after the close of the war was the negotiation of the treaty by which the United States purchased Alaska from Russia in 1867 (*see* Alaska).

Sewerage. You can expect to live longer than your grandfather did, just as his generation lived longer than the one before it. This increase in the span of life is due chiefly to increased knowledge of disease, of hygiene, and of sanitation. Perhaps no factor is more important than the science of sanitary engineering, which reduces disease by safe-guarding our water supply and removing poisonous wastes from our houses (*see* Plumbing; Water Supply).

Sewers are built of brick, cement, or stone masonry, and may be 20 feet or more in diameter. Sewage is carried through them generally by natural flow, or gravitation, although sometimes pumping stations are necessary to distribute it properly. The refuse should be mixed with plenty of water to insure a steady flow—at least 2½ feet a second—and in many places rain water and other surface drainage which must be carried away is conducted into the sewers through the catch basins in the gutters. This plan, however, is open to objections, because sometimes sewer gases escape as the storm water enters. The more sanitary plan is to keep the pipes of the surface drainage system separate from those of the sewer system. In the latter system the flushing of the sewers is done from tanks supplied with water from the city waterworks.

The disposal of sewage, involving some of the most difficult of all engineering problems, has long engaged the attention of city health departments. In small communities each house disposes of its own sewage, usually in the soil, taking care not to contaminate wells or other water supply; but in crowded towns other means must be used.

Sometimes sewage is conveyed out of town to deep water in seas, lakes, or rivers; but even in large bodies of water this often pollutes the drinking water supply, causing typhoid fever and other diseases. It was in order to avoid polluting its water supply from Lake Michigan that Chicago built its $70,000,000 drainage canal (*see* Canals). The more scientific methods of sewage disposal consist of chemical filtration and treatment, so as to kill all organic matter and make the solid matter, or sludge, available as a fertilizer; and the use of bacteria in *contact beds* and *septic tanks* to purify the sewage. Another method is by broad irrigation, or sewage farming—the utilization of sewage in growing crops. The sewage is run over a large area of land and left to oxidize in the air. The Chinese and some Europeans thus make use of material which otherwise would be wasted.

Modern sewage systems date from about the middle of the 19th century. During the Middle Ages open drains in the streets served as sewers. Later on sewage was conducted to open cesspools on the outskirts of the city. The ancient Romans had sewerage systems far in advance of anything known in Europe until the 19th century, draining the city by three natural streams confined within stone tunnels. The largest of these, the *Cloaca Maxima*, parts of which date from the 3d century B.C., is still in use.

A USEFUL ART *That Can Be* FUN

In Learning to Plan, Cut Out, and Make Attractive Clothes, These Girls Are Developing a Valuable Hobby

Sewing. Girls and women have in sewing a personal handicraft. From beautiful fabrics they can fashion clothes that are a pleasure to make and to wear. Sewing used to require hours of patient labor. Every stitch had to be taken by hand. But the sewing machine removed much of this drudgery. Today the home seamstress does tedious stitching on the machine. She needs hand sewing only in basting, finishing, and mending. If she enjoys hand work she may use it to make fine blouses and lingerie.

In learning to operate a sewing machine it is best to have the help of some one who knows how to use

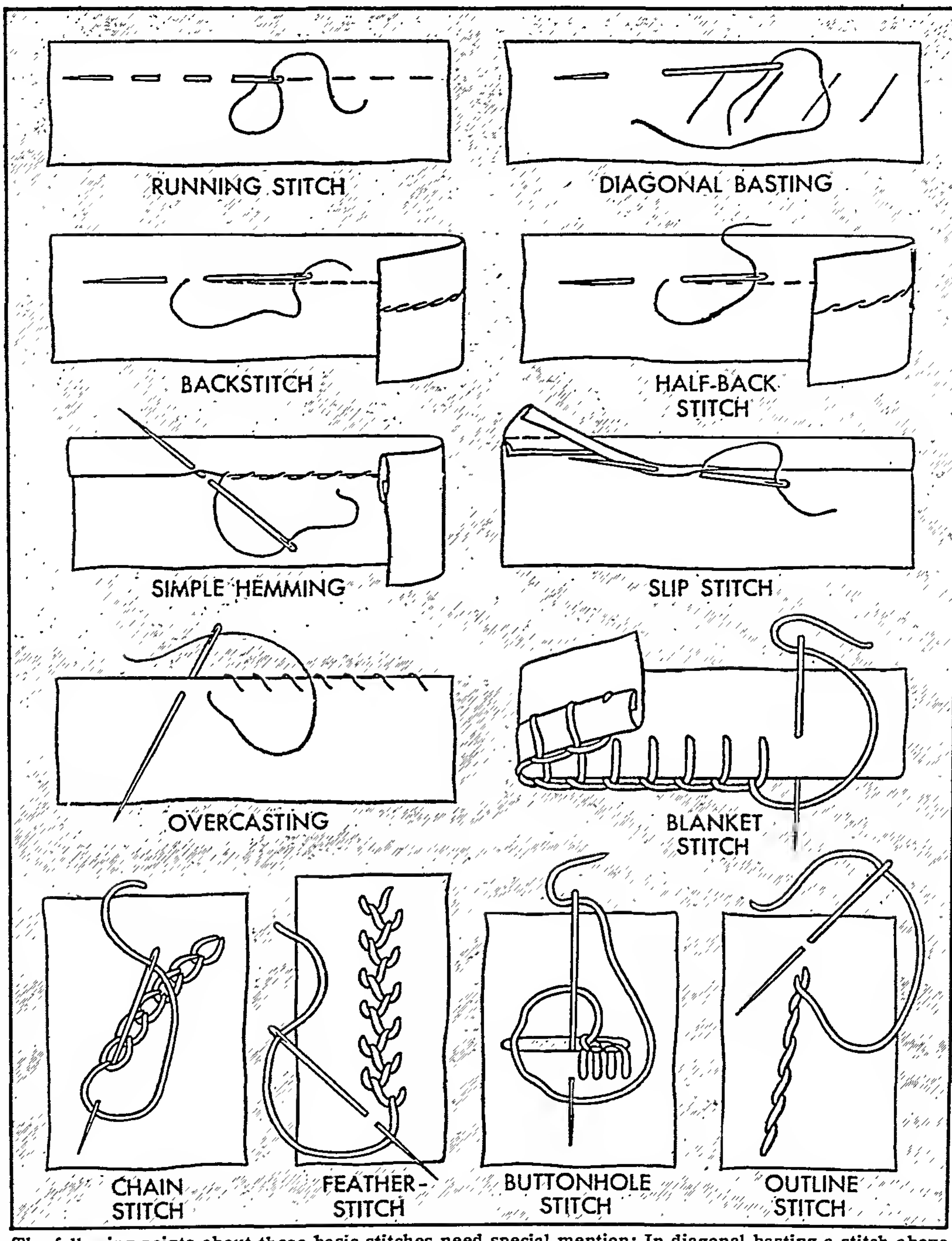
the machine and its "attachments." ("Attachments" are parts that can be substituted for the regular sewing machine foot to do tucking, gathering, and so on.) The beginner may be able to get instruction from a member of her family who knows how to use a machine, from a sewing or home economics teacher in her school, or from an expert at a school maintained by a sewing machine company.

This article describes and illustrates fundamental stitches in hand sewing, as well as basic sewing procedures.

Basic Stitches

The picture on this page shows 12 important stitches. The simplest is the *running stitch.* This is done three or four stitches at a time. The seamstress suits the length of the stitch to her need. Before the days of the sewing machine, "sewing a fine seam" was done with small, even running stitches. The chief uses of a small running stitch today are in hand gathering and in mending. A long, even running stitch serves as *even basting* to hold parts of a garment together in preparation for machine stitching. An occasional backstitch makes the basting firmer. *Uneven basting* (short stitches taken rather far apart) is satisfactory when there will not be any pull on the basting. *Diagonal basting* like that pictured is useful when two rows of basting are necessary, as in basting a facing to a collar. Diagonal basting done with short vertical stitches taken about three-quarters of an inch apart prevents slipping of several layers, as when one is basting both a facing and an interfacing to a garment.

HERE ARE TWELVE IMPORTANT STITCHES

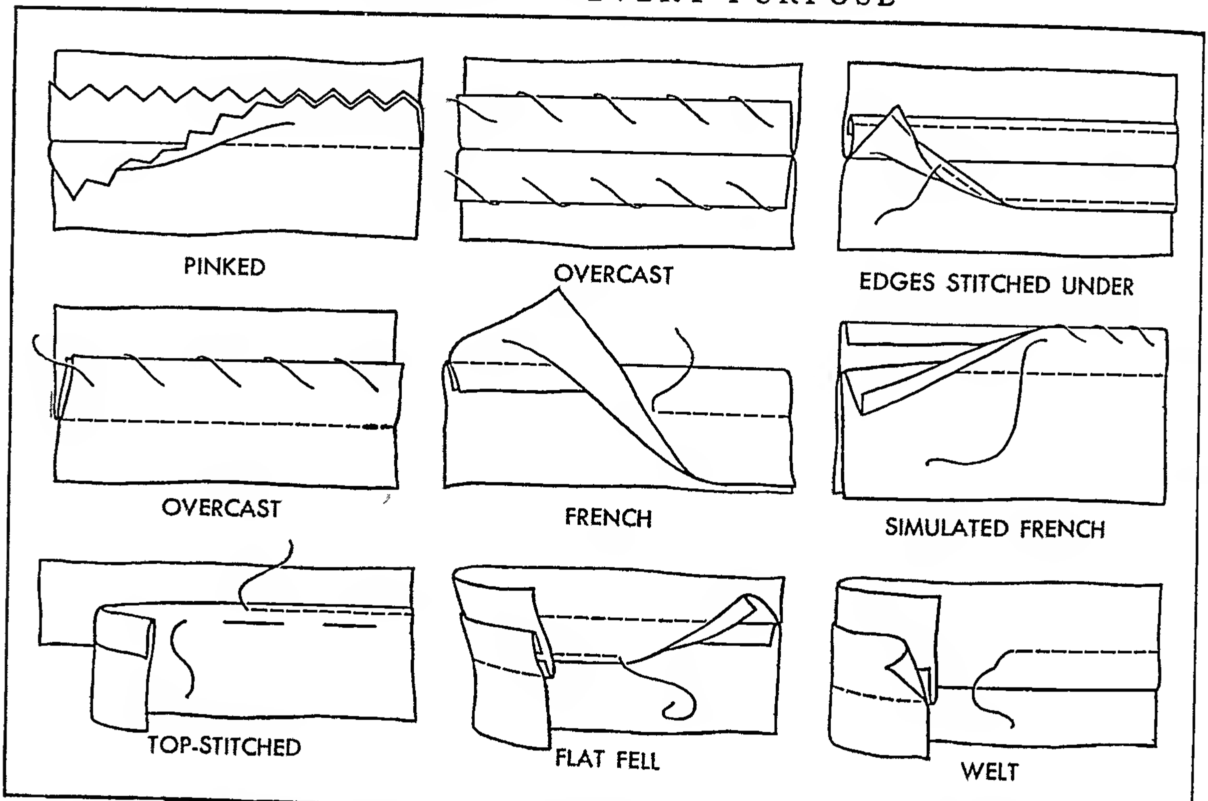


The following points about these basic stitches need special mention: In diagonal basting a stitch above alternates with one below. In the backstitch the needle is inserted at the point at which it came out. In the half-back stitch it is inserted halfway back. Hemming and slip-stitching will scarcely show on the right side if the needle picks up only one or two threads in the garment. In the blanket stitch the thread makes a half-loop behind the needle. In the buttonhole stitch it makes a complete loop.

An even *backstitch* looks on the right side like machine stitching. It is a good firm stitch, very useful for mending ripped seams. The *half-back stitch* is quicker but not as strong.

Simple hemming is the easiest way to secure hems bindings, and facings. The *slip stitch* is a more professional stitch for the same purposes. Since the needle moves from stitch to stitch inside the fold of the hem or facing, the slip stitch is invisible on the wrong side in addition to being almost invisible on the right side.

SEAMS FOR EVERY PURPOSE



Pinked and overcast seams and those with the edges stitched under are simple, easy seams. A French seam is stitched on the right side, trimmed, opened, pressed, and stitched on the wrong side. A simulated French seam is a plain seam with the edges turned in and caught together with overcasting or running stitches. In top-stitching, one edge is turned and stitched over the other. A flat fell is stitched on the right side, one edge is trimmed, and the other is turned under and stitched flat. The welt is stitched on the wrong side, one edge is trimmed, and the seam is pressed, final stitching is on the right side.

Overcasting resembles whipping. The latter appears on the rolled and whipped hem in the picture on page 113. Both overcasting and whipping can be done one stitch at a time, as in the picture of overcasting on this page, or several stitches at a time, as shown on the rolled and whipped hem on page 113.

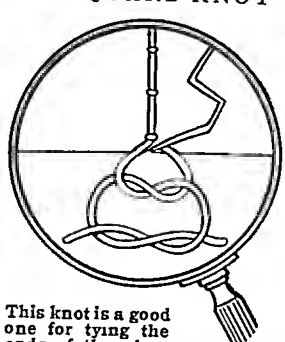
The *blanket stitch* and the *buttonhole stitch* are similar, but the buttonhole stitch, with its complete looping of the thread behind the needle, gives a firmer, stronger edge. The blanket stitch makes a decorative finish for the edges of embroidered luncheon sets, aprons, and so on. This stitch has a quite different use in worked loops like those shown in the lower picture (left) on page 114. Finishing the squared ends of worked buttonholes, as illustrated in the right-hand panel on page 114, provides still another use for the versatile blanket stitch.

The *chain stitch, featherstitch* (or *briar stitch*), and *outline stitch* are simple embroidery stitches, easy to learn and attractive as trimming on infants' and children's clothes.

A Variety of Seams

A plain seam is a stitching together of two raw edges to join the parts of a garment or other article. The raw edges usually need some sort of finish to prevent fraying and to give a neat appearance. The picture at the top of the page illustrates nine important seams. Pinking is the quickest finish if pinking shears are available. It is good on firm materials, but if the fabric frays, overcasting is safer. The two edges may be overcast together unless this makes too much bulk. Turning the edges under separately and machine stitching them is a neat finish for nonbulky fabrics, such as woolen flannel.

A SQUARE KNOT

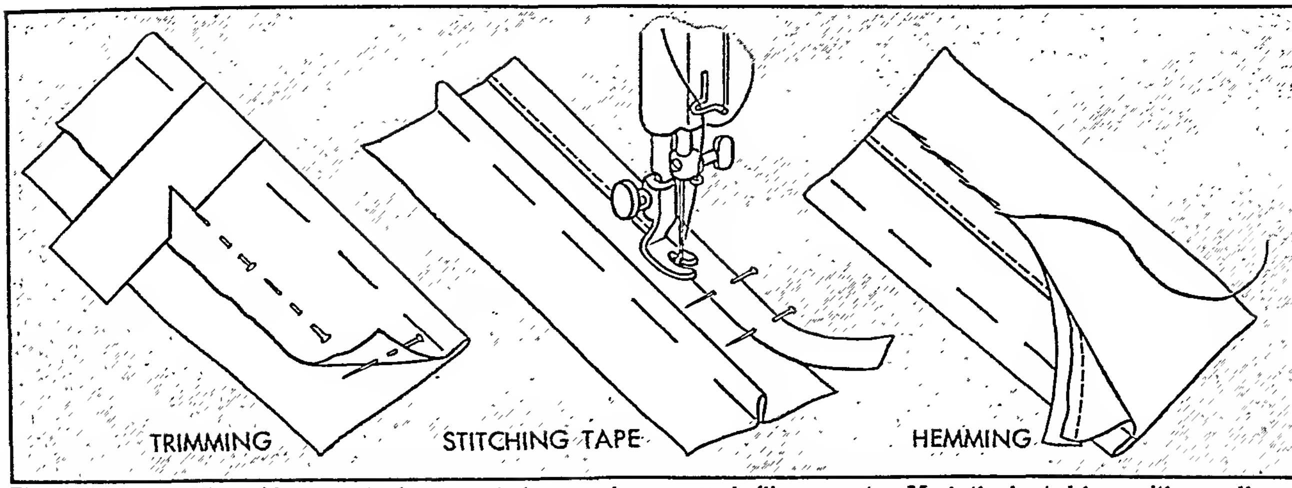


This knot is a good one for tying the ends of thread in machine sewing. The first loop should be drawn up before the second is formed. Note carefully the direction of the threads.

Undergarments, children's cottons, and dresses and blouses of sheer fabrics often need *French seams.* This type is a double seam and is not satisfactory on curves or on heavy materials. The *simulated French seam,* not quite so stiff, is excellent for washable dresses and blouses. It is also a means of correcting badly frayed seams on ready-made garments. Turn under the edges of existing seams and catch them together as in the picture at the top of the page.

Patterns often call for a *top-stitched seam* to emphasize a certain line. The skirt and blouse of a dress are usually put together with this seam. The *flat fell* appears on pajamas, shorts, slacks,

THIS IS THE CLASSIC HEM



The three pictures above illustrate the best way to hem wool, rayon, and silk garments. Mark the basted hem with a cardboard gauge, using pins or chalk. Two inches is a good width. After trimming, stitch rayon seam binding to the edge. To secure the hem use a simple hemming or catch stitch. The catch-stitch, a form of cross-stitch, is shown in the picture below.

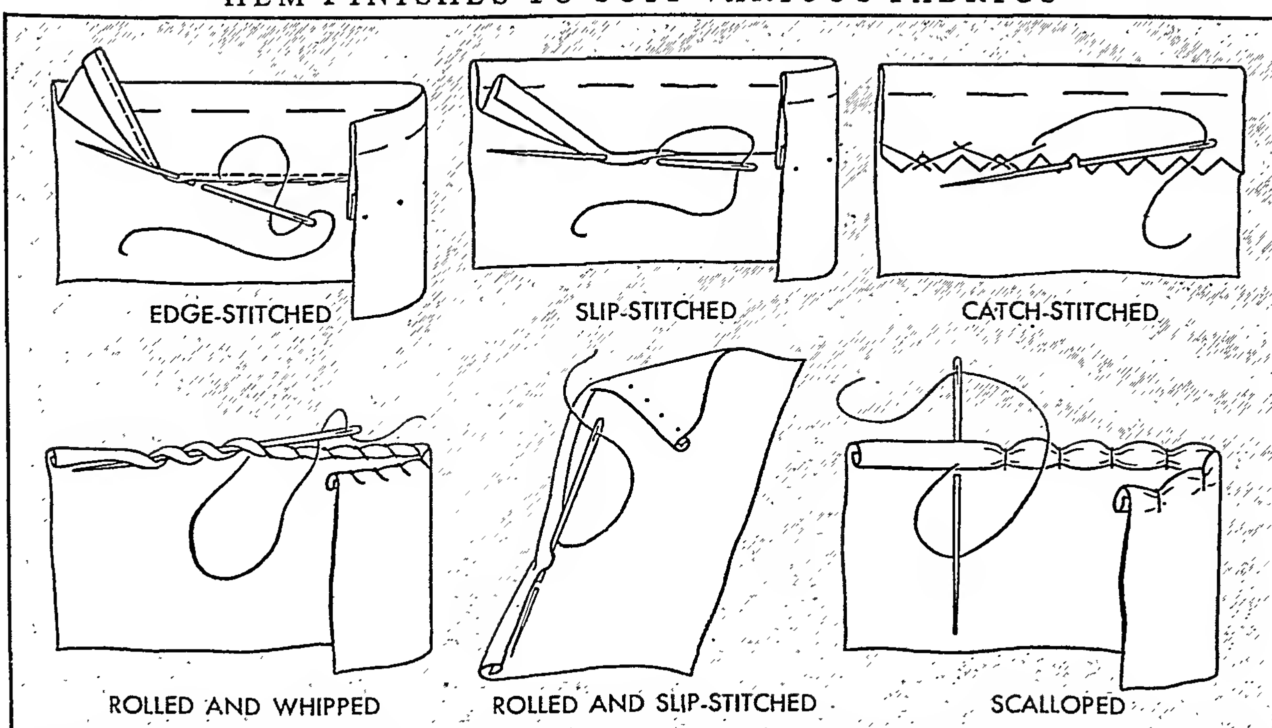
and other sportswear. The *welt* is an ornamental seam for lined jackets and coats.

Here are a few hints for successful seams: If one seam is to cross another, press it before basting or pinning the second seam. When attaching a gathered edge to a straight one, hold the gathered edge uppermost. When joining a bias edge to a straight edge hold the bias uppermost and take care not to stretch it.

Hems Are Important

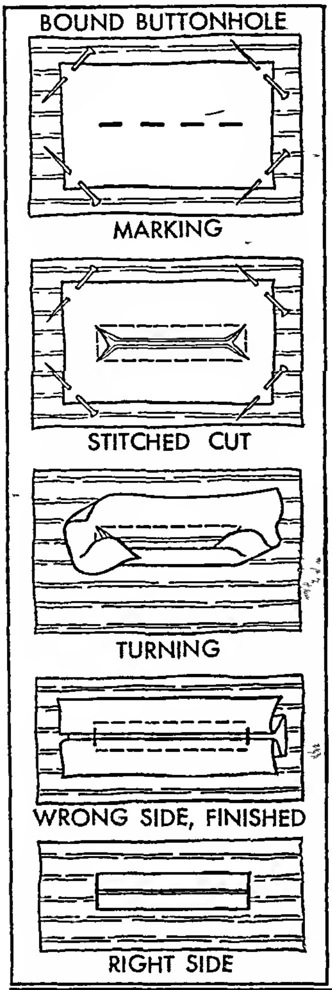
A badly hanging hem spoils the appearance of any garment. To alter the hem on a ready-made dress or skirt, rip it and press out the crease. Then put in a new hem. The most satisfactory way to hem a garment is as follows: Have some one mark the correct hem line with chalk or pins, using a yardstick and measuring from the floor. Turn up the hem and baste it close to the fold. Mark the width of the hem with chalk or pins and trim off the excess. Then finish the hem, choosing the method best suited to the fabric. The pictures on this page show a number of standard finishes. If it is necessary to face a hem follow the method illustrated on page 115. On children's dresses a tuck set into the wrong side of the hem provides two or three extra inches which can be let down later.

HEM FINISHES TO SUIT VARIOUS FABRICS



The edge-stitched hem is good on firm but not bulky materials. Slip-stitching makes a fine hem for fine fabrics. Pick up only a thread or two of the garment and then run the needle along in the fold of the hem about one-half inch. Catch (or cat) stitching over a raw or pinked edge is excellent on firm heavy wools that do not fray. A rolled hem, whipped or slip-stitched, provides a dainty finish for sheer materials. Machine stitching close to the edge makes rolling easier. In doing a decorative scalloped hem, pull the blanket stitch tight and move the needle from stitch to stitch inside the lower fold.

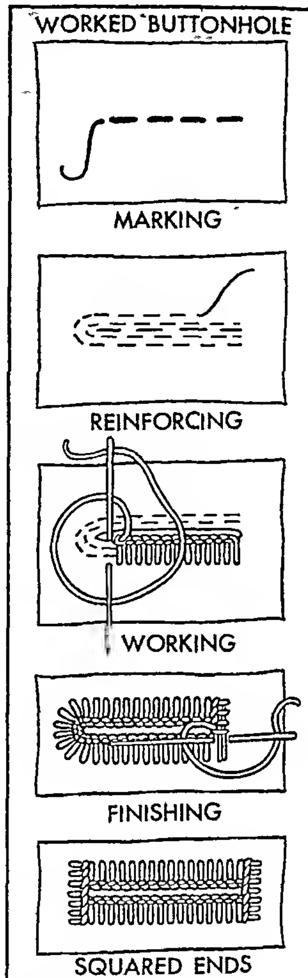
HOW TO MAKE BUTTONHOLES AND DO ODD JOBS

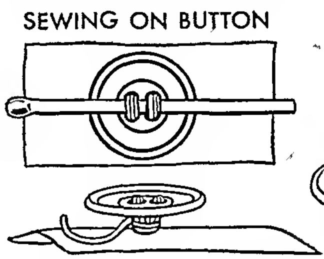


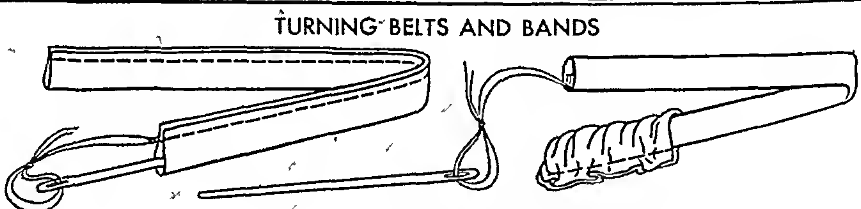
Making bound buttonholes may seem to be a difficult task. With practise and care, however, you can learn to make buttonholes that look professional. Mark the desired length on the garment, using a short basting stitch. Then proceed as in the panel of pictures at the left. The binding piece is cut square with the grain of the cloth. The top picture shows this piece pinned and basted to the right side of the garment; the grains should match. The basting serves also as a marking. Stitch by machine or else backstitch by hand. Turn the piece through to the wrong side and adjust. Pleat and oversew the ends. Sew around the binding, keeping the stitches invisible on the right side. Usually a garment edge bearing buttonholes is faced. Slash facing at the buttonhole, turn in edges, and hem them to the buttonhole. If there is no facing, finish binding edges with overcasting.

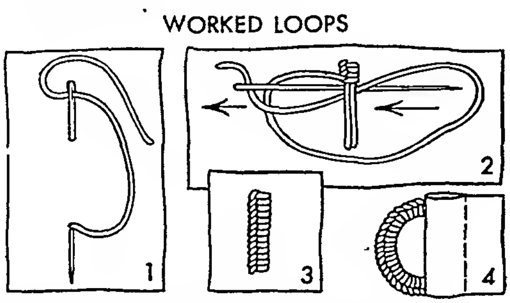
Worked buttonholes call for careful hand work. The panel at the right shows the various steps. Do reinforcing on the machine or with a hand running stitch. Space the buttonhole stitches closely and evenly. Work the rounded end with buttonhole stitches and the bars at squared ends with blanket stitches.

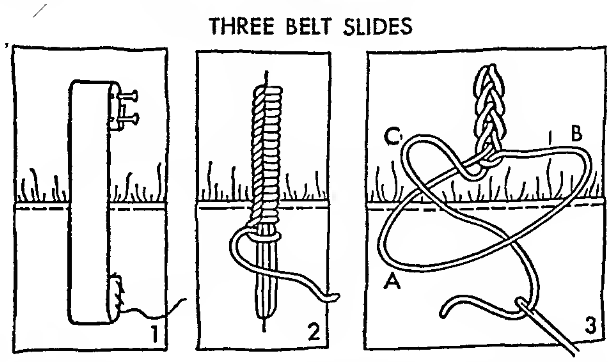
The pictures below show a number of handy procedures. A button sets better in its buttonholes if it has a shank, which is a sort of stem. A pin or a match may be used to make slack to form the shank. Turning a belt with a bodkin, as illustrated, means that both ends are open. Turn the raw edges in, according to the shape of belt ends desired, and slip-stitch them together.





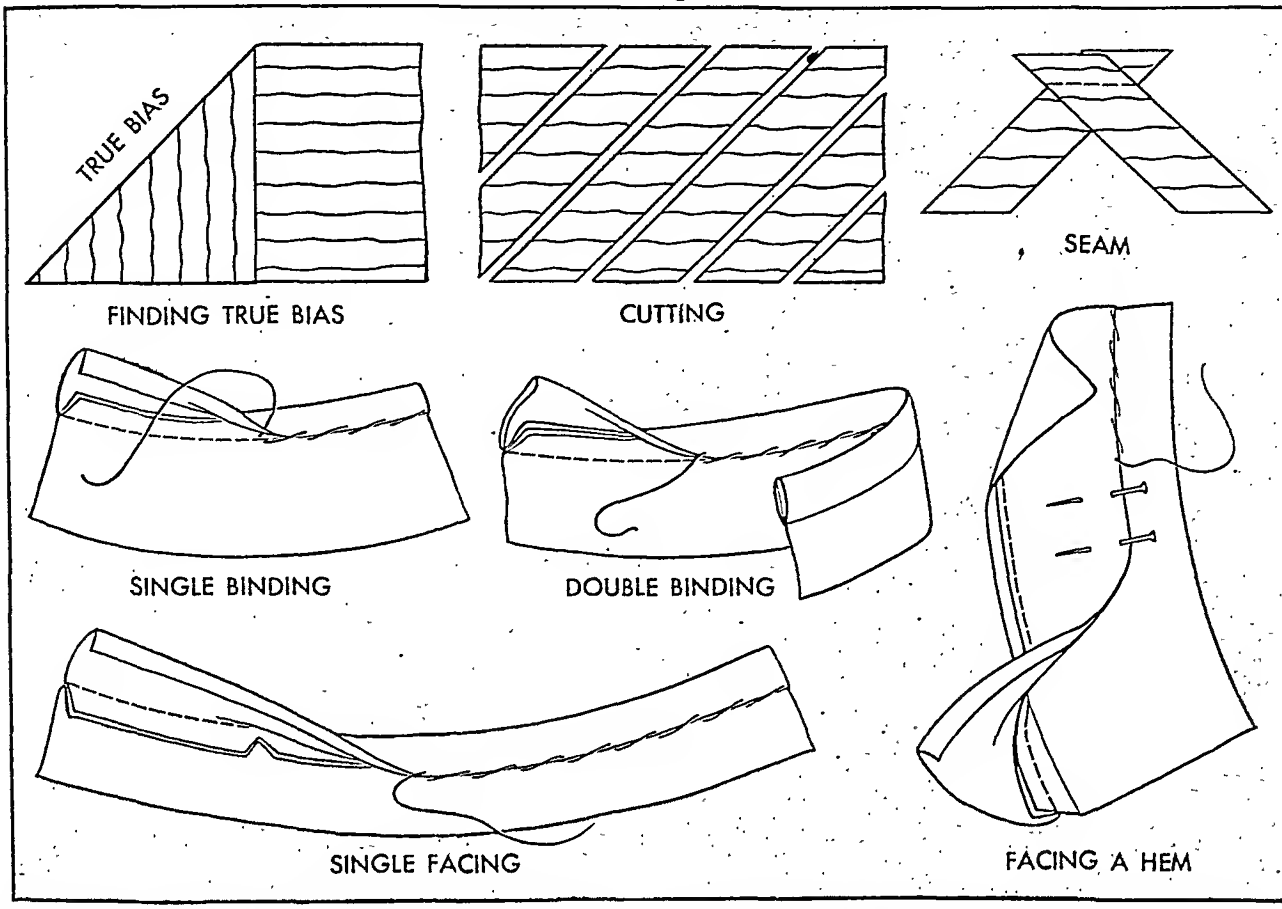






The text explains how to make the bound and worked buttonholes pictured on this page. A match placed over a button before it is sewed on makes the thread form a shank. A few twists of thread around the shank stiffen it. Turning a stitched band is easy if the ends from the stitching are threaded into a bodkin and tied. Make worked loops with buttonhole twist. Begin with two or three loose stitches (1) and cover with blanket stitch (2) to make a hook eye (3) or a button loop (4). Belt slides may be tailored (1), blanket stitched (2), or hand crocheted (3). To hand crochet a belt slide, fasten thread to the garment and pull up a loop. Insert your thumb in loop at (A), your forefinger at (B). Start a new loop (C) with your middle finger. (Hold needle in your other hand.) Pull up new loop (C) to close first loop (A-B) and repeat. To finish draw thread through the last loop and fasten to garment.

FACINGS AND BINDINGS REQUIRE TRUE BIAS STRIPS



A true bias is the diagonal of a square. The three pictures at the top explain how to fold material to find the true bias, how to cut the strips, and how to seam them together. Press the seams open. If the fabric is of average thickness or is bulky use a single binding. If it is lightweight fold the bias strip and apply it double. Facings too may be applied single or double. The modern method of facing a hem, shown above, gives a flat facing. Turn under both edges of the facing and press them. Then top stitch the facing to the edge of the skirt. Secure the hem with a common hemming stitch or a slip stitch.

A tiny worked loop of fabric-colored buttonhole twist makes an inconspicuous eye for a hook. Worked loops and small buttons look well at neck openings and on cuffs. Leading with the eye of the needle in blanket-stitching worked loops eliminates the risk of splitting the loop with the point of the needle.

Choose belt slides to suit the garment. Slides made of narrow stitched bands are best for tailored garments. Worked or hand-crocheted slides are daintier. Worked slides are long, worked loops. Hand-crocheted slides are favorites with professional dressmakers.

There are two kinds of facings, shaped and bias. Shaped facings are part of the garment pattern and will not be discussed here. The pictures on this page illustrate the application of bias facings and bindings. These two finishes are similar. In applying a facing, however, the seamstress folds back both facing and garment at the seam line. In applying a binding she turns back only the binding, so that the fold is at the edge of the garment.

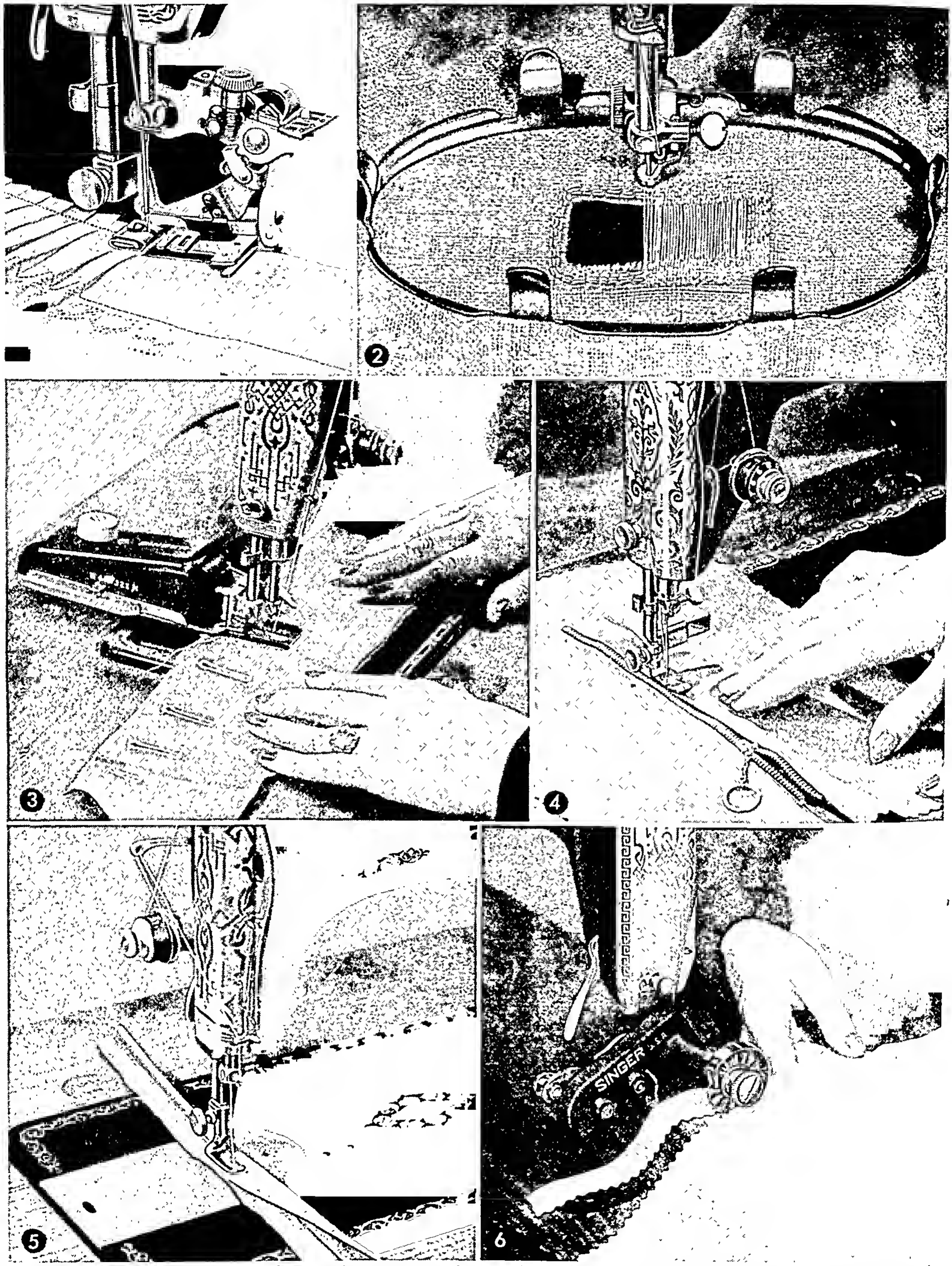
A Word About Dressmaking

To the beginner: Pick out a pattern that has detailed cutting and making directions. Take care to choose a simple style. Some pattern manufacturers indicate which of their patterns are "easy to make." Measure your figure carefully in order to get the right size. Buy an inexpensive, firmly woven cotton in a becoming color for your first venture. Avoid stripes, plaids, or any other design that may need matching at seams. Follow the cutting and sewing directions of the pattern faithfully. Press seams as you make them; step-by-step pressing is essential. Your patience will be well rewarded.

SEWING MACHINE. From the middle of the 18th century many inventors in England and the United States tried to make machines that would imitate the movements of the needlewoman's fingers. The fundamental principles of the successful sewing machine were specified as early as 1790 by the Englishman, Thomas Saint, who patented a machine for sewing leather but made no practical use of it. In 1830 Barthelemy Thimonnier, a poor French tailor, patented a machine, using it for sewing army clothing. In 1831, when he had 80 such machines in use in Paris, an angry mob wrecked the machines, Thimonnier barely escaping with his life. He died in poverty in 1857 after years of struggle to get his machines adopted.

Between 1832 and 1834 Walter Hunt, a Quaker, built in his New York shop a machine "for sewing, stitching, and seaming cloth." His machines could not do curved work or sew a seam more than a few inches without readjusting the cloth.

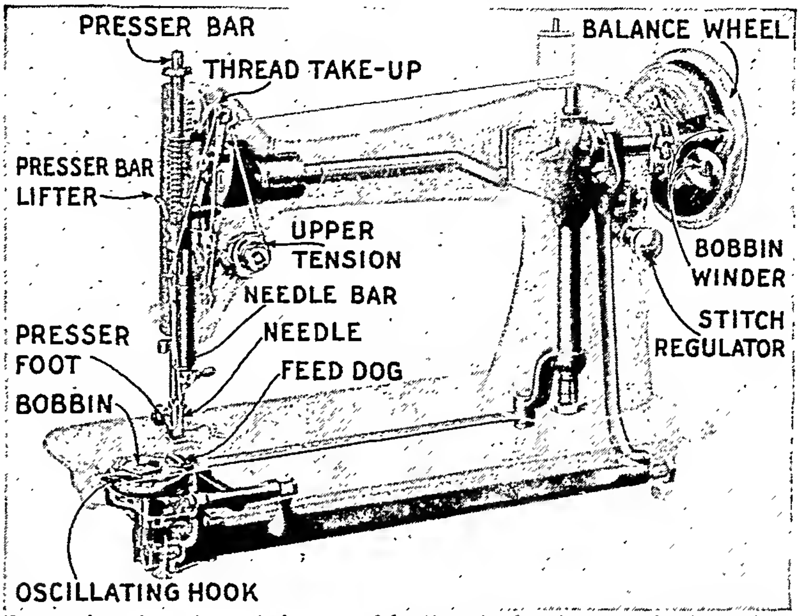
INGENIOUS ACCESSORIES FOR THE MODERN SEWING MACHINE



1. When used for pleating, the *ruffling* attachment automatically tucks material into pleats and stitches them down. 2. The *flat darner* is used to stitch across a hole first one way, then the other, while the material is held taut in an embroidery hoop. The result is a strong clothlike darn. 3. The *buttonholer* automatically forms buttonholes of many sizes. The only hand operation is slitting the cloth. 4. The *zipper foot* attachment allows an operator to stitch close to the edge of a metal slide fastener. 5. The *cording foot* stitches along the left side of the raised cord, permitting material to hang over the left-hand edge of the table. 6. The rotary knife of the *pinking* attachment cuts cloth in a wavy line which prevents raveling.

Hunt sold his interest in the machine for a trifling sum to George A. Arrowsmith, a New York blacksmith; but Arrowsmith refused to patent it, fearing that it would rob many seamstresses of their work. Hunt was a prolific inventor, listing among his productions machinery for making nails and rivets, a street-sweeping machine, a revolver and a repeating rifle, and the safety pin. Eventually he bought back his rights to his sewing machine from Arrowsmith, but never devoted himself to its perfection and never realized any great sum on it. So it was not until about the middle of the 19th century that substantial progress was made toward the practical sewing machine.

THE SECRETS OF THE SEWING MACHINE

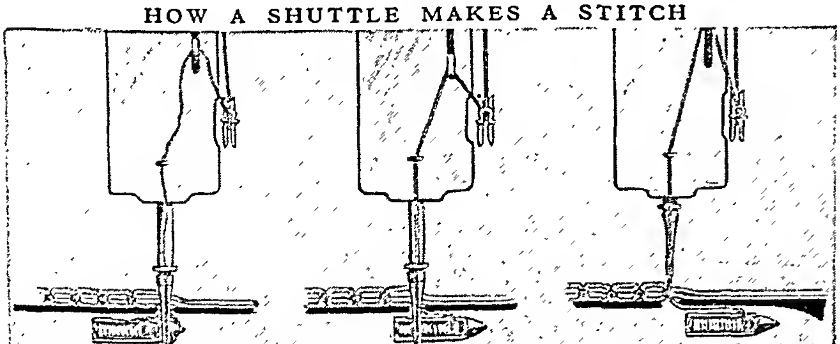


The motion of the bent shaft—turned by the wheel and motor—is changed by cams and levers into the up-and-down motion of the needle bar, the to-and-fro movement of the feed dog, and the rhythmic swinging of the "oscillating hook." The take-up makes the thread alternately tight and loose as needed; the stitch regulator controls the length of the stitch.

By that time it was realized that it was not necessary for the whole needle to go through the cloth for each stitch; and the machine needle, with an eye near the point, and the "lock stitch"—such as are in use today—had appeared. The lock stitch makes use of two threads. The first thread, passing through the eye of the needle, is pushed down with the needle through the cloth, and forms a loop below. The other thread, underneath the cloth, is carried through the loop by a shuttle, thus "locking" the stitch.

Such a needle was combined with the lock stitch in a machine patented in 1846 by Elias Howe of Massachusetts. This was the first really practicable sewing machine, but it could sew only straight seams, and the seams could not be longer than the baster plate. The needle moved back and forth horizontally instead of vertically, as in our modern machines. Howe and his machine were denounced by garment workers and tailors, who feared it would deprive them of their means of livelihood. But gradually his machine came into use, and in 1854 the courts sustained him in a long legal fight over patent rights. For about 25 years Howe collected royalties on every machine made, and thus was lifted from poverty to a fortune of more than $2,000,000 (*see* Howe, Elias).

HOW A SHUTTLE MAKES A STITCH



The three pictures above show how the upper thread catches up the lower to make the famous "lock stitch," the shuttle passing through the loop in the upper thread each time the needle comes down. As the needle rises, the take-up draws the thread taut, pulling the stitch up into place between the layers of material being sewn. Poor adjustment of the tension on the thread may cause the stitch to be improperly made, or the thread may even be broken or snarled.

One of the defects in the early inventions even in Howe's first machines, was that the cloth had to be "fed" by hand. John Bachelder devised the first machine combining the horizontal table with a continuous feeding device that would sew any length of seam, and patented his improvements in 1849. He used a leather belt set with small steel points to carry the material along. The greatest improvement was made by Allen B. Wilson, a Michigan cabinetmaker, who in 1854 patented his "four motion feed," employed in almost all machines today. This device consists of a toothed metal plate which moves forward, carrying the cloth with it, then drops out of contact with the cloth, moves back, and rises to push the cloth forward.

Meanwhile, Isaac M. Singer had invented the first "rigid arm" sewing machine, and had made important improvements in the shuttle. He finally obtained a patent after a long lawsuit with Howe. James Gibbs invented a "chain stitch" machine, later improved by James Willcox of Philadelphia. In this machine the loop of each stitch passes through and secures the loop of the previous stitch.

These early machines have been developed to such an amazing extent, both for home and factory uses, that today there are machines for sewing almost every conceivable article of clothing, upholstery, embroidery, canvas, leather goods, etc., some of which run as

fast as 5,000 stitches a minute. There are machines for making buttonholes and others for sewing on buttons. There are machines for faggoting, featherstitching, pattern stitching, hemstitching, smocking, ruffling, tucking, side and box plaiting, basting, and quilting. There are single and double needle machines, and those with four, six, and eight needles for the making of gloves.

Of these special machines the most important is the shoe-sewing machine (*see* Shoes). The household type too has been improved and modified, chiefly in order to carry special attachments, until now the same machine can handle a great variety of work. Both industrial and domestic machines are now commonly run by electric motors. They were introduced in 1889. The United States leads the world in the manufacture of sewing machines. Its output goes to the remotest parts of the globe.

SHAD. The American, or common, shad, weighing from three to six pounds, is an important food fish. It is also prized for its roe (eggs). It lives deep in the Atlantic Ocean, but in spring it swims up coastal rivers to spawn. During these runs, millions of pounds of shad are caught with nets. The chief fisheries are on Chesapeake Bay, Delaware Bay, and North Carolina sounds and on the Hudson, the Potomac, and the Connecticut rivers. In 1871 shad were introduced into the Pacific Ocean and they are now caught commercially in the waters off California, Oregon, and Washington.

Shad belong to the herring family but are larger and have deeper bodies than the typical herring. The American shad has the scientific name *Alosa sapidissima*. Two other species, the allice shad and the twaite shad, are found in the eastern Atlantic and in the Mediterranean Sea. (*See also* Fish.)

SHAKESPEARE—*His* LIFE, *His* ART, *and His* TIMES

SHAKESPEARE, William (1564–1616). Most of the important known facts about Shakespeare's life are contained in the brief summary on the next page. We also know the dates when his plays were first published and the approximate times when they were composed. Scholars digging in old records have brought to light a few other items relating to his purchases of property, places of residence, and lawsuits, none of them very interesting or important. All that we have beyond this meager body of recorded fact is a mass of legend, traditions, and conjecture, often plausible enough, but not resting on documentary evidence.

Why do we know so little about so great a man? Why did no one attempt to write his life until nearly a hundred years after his death? There is no mystery about it, as many think. The explanation is that the lives of authors excited no curiosity in his time. We know more about Shakespeare than we do about most of his contemporaries, unless they were of the nobility. If to the known facts we add plausible tradition and conjecture, we can build up a fairly complete narrative of his life.


This bust of Shakespeare in the church at Stratford was carved by Garret Johnson shortly after the poet's death.

The Poet's Family and Early Life

William Shakespeare was born in Stratford-on-Avon in the sixth year of the reign of Queen Elizabeth I. He was the eldest son and third child of John and Mary (Arden) Shakespeare. The day of his birth is not known, but he was christened on April 26, 1564, and April 23, the feast of St. George, the patron saint of England, has long been celebrated as his birthday. Two sisters, Joan and Margaret, died before he was born. The other children were Gilbert, a second Joan, Anne, Richard, and Edmund, of whom only Joan survived him.

His father was a tanner and glovemaker, an energetic man, who was for years an alderman of Stratford and for a term high bailiff or mayor. John Shakespeare's fortunes declined toward the end of his life, so that when he died in 1601 he was able to leave William only a little real estate. Of Mary Shakespeare (who died in 1608) we know little except that she was of better family than her husband; her father had been John Shakespeare's landlord.

Stratford-on-Avon is in Warwickshire, a county often called the "heart of England," because it is in the middle of the kingdom—a beautiful county, even then rich in agriculture, though more heavily wooded than it is now. The town was prosperous, clean, and progressive. Not far away were the great castles of Warwick and Kenilworth, and the Forest of Arden. The town was proud of its grammar school, which Shakespeare no doubt attended, though when or for how long is not known. The tradition is that he was a pupil

WHERE THE POET LEARNED HIS LESSONS

In this room, with its timbered roof, Shakespeare doubtless learned his "small Latine and lesse Greeke"; for this is the old Grammar School, in which Stratford boys have been taught from before Shakespeare's time to the present.

there between his 7th and 13th years. His studies must have been mainly in Latin. There is no reason to suppose that his schooling was not good; all the four schoolmasters connected with Stratford Grammar School during the boyhood of Shakespeare were graduates of Oxford University.

Concerning his boyhood years we know nothing definite, but we can safely assume that he had a rare opportunity to become acquainted with the objects of nature, with outdoor sports and trades, and with the rural folk whom he was later to portray with such humor. He certainly amassed a fund of knowledge then and later, for he picked up an amazing stock of facts about hunting, hawking, fishing, dances, music, and other arts and pastimes, as well as about alchemy, astrology, folklore, medicine, and law. His information was of the sort which a poet collects, not only from books, but also from day-by-day observation and hearsay.

He Marries and Goes to London

In 1582, when he was 18, he married Anne Hathaway of Shottery, a little village a mile from Stratford. She was seven or eight years his senior and, evidently on no better foundation than this difference in their ages, a tradition arose that they were not happy.

What he was doing between 1583 and 1592 is not known, though traditions exist that he taught school, was employed in a lawyer's office, was retainer on a gentleman's estate, and traveled with a company of players. The most famous of the legends of this time tells how, about 1584, he and some companions were arrested for poaching on the estate of Sir Thomas Lucy of Carlecote, near Warwick, and were forced to leave town. The story is accepted by some authorities and rejected by others. Less probable is the tradition that he was in London in 1588, holding horses for patrons of the theaters in Shoreditch, and was in time employed indoors as a servitor or callboy.

At any rate, we know that he was in London in 1592, already recognized as an actor and playwright by the time he was 28 years old. In that year the first literary reference to him was made by Robert Greene, another playwright, who accused him of borrowing from the plays of others. Since plague kept the London theaters closed most of the time between 1592 and 1594, Shakespeare occupied himself with the writing of his earliest sonnets and two narrative poems, 'Venus and Adonis' and 'The Rape of Lucrece'. Both 'Venus' and 'Lucrece' were printed by a boyhood friend from Stratford, Richard Field, and both were dedicated to Henry Wriothesley, Earl of Southampton. They were well received by the public and helped to establish him as a rising poet.

His Theatrical Ventures Prosper

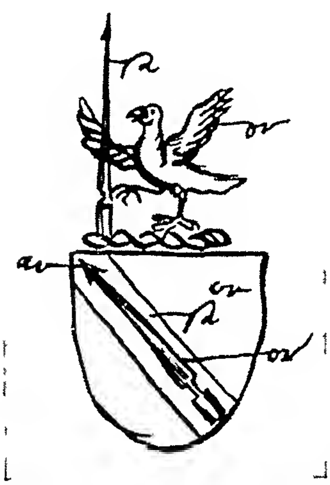
Until 1598, Shakespeare's theatrical activities were apparently confined to the district northeast of London, outside the walls, in the parish of Shoreditch adjoining Finsbury Fields, a favorite spot for picnics, drills, and athletic sports. There two playhouses—the Theatre and the Curtain—were situated. These were under the management of James Burbage, who was the father of Richard Burbage, the greatest tragic actor of the day and Shakespeare's friend. In 1596—and probably for some years before—Shakespeare was living near these theaters in Bishopsgate, where the great North Road entered the city; but some time between that year and 1599 he moved across the river to the district called the Bankside, where two theaters, the Rose and the Swan, had been built by Philip Henslowe, James Burbage's chief competitor as a

CHIEF KNOWN FACTS OF SHAKESPEARE'S LIFE

1564. Born at Stratford-on-Avon, Warwickshire, probably April 21–23, and baptized, April 26
1582. License issued for his marriage with Anne Hathaway of Shottery
1583. Daughter Susanna born
1585. Twins Hamnet and Judith born
1592. First alluded to in a book, by Robert Greene
1593. 'Venus and Adonis' published
1594. 'Rape of Lucrece' published
1596. His son Hamnet dies
1596. His father is granted a coat of arms
1597. Purchases New Place in Stratford
1598. Is praised by Francis Meres, who mentions his poems and sonnets and names 12 of his plays
1603. He and his fellow players are honored by James I; appointed Grooms of the King's Chamber
1607. Daughter Susanna marries
1609. 'Sonnets' published
1610–13. Retires to Stratford
1616. Daughter Judith marries
1616. Dies, April 23, and is buried, April 25

theatrical manager. To this district the Burbages also moved in 1598 and built the famous Globe Theater—so called from its sign, a representation of Atlas supporting the world. With this theater Shakespeare's fortunes were to be connected for the rest of his active life. In it he owned a share, which was the source of most of his subsequent wealth.

Meanwhile, in 1597, he had bought New Place, the largest house in Stratford, and in the next three years he purchased other property there and in London. In the previous year his father, probably at his suggestion, had applied for and been granted a coat of arms. The arms consist of a gold shield with a gold spear on a black bend; above this is the crest, a silver falcon flapping its wings and holding another spear. The motto is *Non sanz droict* (Not without right). From this time on, Shakespeare could write the word "Gentleman" after his name. When we consider that in those days actors were classed legally with rogues and vagabonds, we can understand his desire to win this standing.



Sketch accompanying the grant of arms to Shakespeare's father in 1596. The word "or" means gold.

In 1598 his name first appeared on title-pages of printed plays, and in the same year Francis Meres, in 'Palladis Tamia: Wit's Treasury' (a sort of literary handbook), praised him as poet and dramatist and mentioned twelve of his plays by name in terms which prove that his excellence was even then well recognized.

Honored as Actor and Playwright

From about 1602 to 1607 Shakespeare was lodging with a French Huguenot wigmaker, Christopher Mountjoy, and interesting himself in the love affair of his landlord's daughter. He was later rewarded for his efforts by being called as a witness when, in 1612, the young husband sued his father-in-law over the daughter's dowry. In 1603, upon the death of the Queen in that year, the theatrical company to which he belonged was taken under the patronage of James I as the King's Company, and he and his fellow players were made officers of the royal household.

The company with which he was connected as actor and playwright was the most successful company of the time, known successively as the Earl of Derby's, the Lord Chamberlain's, and the King's. In 1608, as the King's Men, the company acquired the Blackfriars Theater in the city, a smaller and more aristocratic house than the Globe. From that time it alternated between the two playhouses. Plays by Shakespeare were performed at both theaters, at the court, and in the palaces of nobles. After 1603 he probably acted little. He appears to have been a competent "character" actor. Late traditions assign to him the rôles of old Adam in 'As You Like It', and of the Ghost in 'Hamlet'. A contemporary poet, however, in 1610 speaks of his performing "kingly parts in sport."

In 1607, when he was in his early forties, he may have suffered a serious physical breakdown. For years he had written two plays a year and sometimes three—a prodigious feat of industry even without his work as an actor. In the same year his elder daughter Susanna married John Hall, a physician, and in the following year bore Shakespeare's first grandchild, Elizabeth. Also in the same year, 1607, his youngest brother Edmund, who had come to London and had become an actor, died at the age of 27.

Poet-Friends of the Mermaid Tavern

By this time or not long after, Shakespeare was a member of the famous group of men of letters who congregated at the Mermaid Tavern in Cheapside. The club was founded by Sir Walter Raleigh, and Ben Jonson was its leading spirit. Shakespeare was a popular member, admired for his talents and loved for his kindliness. Thomas Fuller, writing about 50 years later, no doubt from hearsay, has an amusing account of the conversational tilts of the two poet-friends:

> Many were the wit-combats betwixt him and Ben Jonson; which two I behold like a Spanish great galleon and an English man-of-war; Master Jonson (like the former) was built far higher in learning; solid, but slow, in his performances. Shakespeare, with the English man-of-war, lesser in bulk, but lighter in sailing, could turn with all tides, tack about, and take advantage of all winds, by the quickness of his wit and invention.

Jonson, who occasionally criticized Shakespeare harshly, nevertheless later wrote a eulogy of him as remarkable for its feeling as for its acuteness. In it he said:

> Leave thee alone, for the comparison
> Of all, that insolent Greece, or haughty Rome
> Sent forth, or since did from their ashes come.
> Triumph, my Britain, thou hast one to show
> To whom all scenes of Europe homage owe.
> He was not of an age, but for all time!
> . . . .
> Sweet Swan of Avon! what a sight it were
> To see thee in our waters yet appear,
> And make those flights upon the banks of Thames,
> That so did take Eliza, and our James!

Death and Burial at Stratford

Shakespeare retired to Stratford about 1610, but London friends continued to visit him. In 1613 the Globe Theater burned. This was no doubt a considerable loss, but he was still wealthy. He shared in the building of the new Globe. A few months before the fire he bought as an investment a house in the fashionable Blackfriars district of London. He died at the age of 52, on April 23, 1616. (This is according to the Old Style or Julian calendar of his time. Our New Style date is May 3, 1616, as explained in the article on Calendar.) He was buried in the chancel of the Church of the Holy Trinity in Stratford.

CHURCH AT STRATFORD WHERE SHAKESPEARE IS BURIED

This view of the chancel of Holy Trinity Church shows, in the wall at the left, the Shakespeare monument with the bust which is reproduced in closer view on a previous page. The poet's gravestone is in the pavement inside the rail at the left.

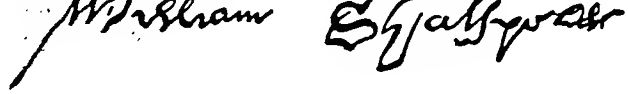
A stone slab—a reproduction of the original one, which it replaced in 1830—marks his grave. It bears the curious inscription, perhaps written by himself:

GOOD FREND FOR IESVS SAKE FORBEARE,
TO DIGG THE DVST ENCLOASED HEARE:
BLESE BE YE MAN YT SPARES THES STONES,
AND CVRST BE HE YT MOVES MY BONES.

On the north wall of the chancel is a monument, consisting of a portrait bust enclosed in an architectural frame, over an inscription in Latin and English, perhaps written by his son-in-law Dr. Hall. This bust and the engraving by Martin Droeshout, prefixed to the First Folio edition of his plays (1623), are the only pictures of the poet which can be accepted as authentic likenesses. Aubrey, an Oxford don, writing 65 years after the poet's death but evidently using information furnished him by the son of one of Shakespeare's fellow-actors, described him as "a handsome, well-shaped man, very good company, and of a very ready and pleasant smooth wit."

Shakespeare's will, which survives, bequeathes most of his property to Susanna and her daughter, leaves small mementoes to friends, and mentions his wife only once, bequeathing her his "second-best bed" with its furnishings. Much has been written about this odd bequest; but there is little reason to suppose it was a slight. Indeed, it may well have been a special mark of affection, for the "second-best bed" was probably the bed of William and Anne; the best bed was reserved for guests. At any rate, his wife was entitled by law to one-third of her husband's goods and real estate and to the use for life of his chief dwelling-house. She died in 1623.

The will contains three signatures of the poet, and these, with three others, are the only known specimens of his handwriting in existence, unless we accept as genuine some lines in the manuscript play of 'Sir Thomas More' which certain experts believe to be his. The first signature on the will is reproduced here:



He appears to have spelled his name in various ways; his father's papers show some 16 spellings, of which Shakspere, Shaxpere, and Shakespeare are the most common.

The Controversy about His Authorship

The outward events of Shakespeare's life seem so prosaic that many persons have found it impossible to believe that such a man could have been the author of the plays. They cannot accept the idea that a man so industrious, sober, and even middle-class in his ways, steadily accumulating wealth, and providing for his family, could have known such heights and depths of passion. They feel that his contemporaries showed strangely little realization of his greatness. Some believe that the Stratford boy who had so little schooling could never have acquired knowledge of the professions and of the aristocratic sports of hawking and hunting, or acquaintance with the speech and manners of the upper classes.

So, for about a hundred years, there has been a persistent effort to prove that Shakespeare did not write the plays, with many attempts to prove that someone else did. The author most often named was Francis Bacon, and the Bacon-Shakespeare controversy has filled a numerous library of books. After the Baconian theory became less popular, the Earl of Oxford and other men were brought forward, until nearly every famous Elizabethan has been named as author. Some theorists have even maintained that "Shakespeare" is merely a pseudonym for a syndicate of poets.

But such persons have not satisfactorily explained the fact that Shakespeare's contemporaries—Meres, for example, in 1598 and Jonson in 1623—did recognize his worth both as a man and as a writer. And to hold that an obscure boy could not have become the Shakespeare we know is to ignore the mystery of genius. His knowledge, remarkable as it is, is not in general of the kind acquired in school. It is precisely the kind a literary genius acquires, because such a genius is insatiably inquisitive. For proof of this, we need but turn to the example of other writers whose educational opportunities were less than those of Shakespeare.

Few scholars take seriously any of the many attempts to deprive Shakespeare of authorship. They feel that the plays are marked by a style so individual and inimitable that any competent critic can recognize it; and this style is found nowhere else. It would be hard to name anyone less likely to have written them than Bacon, who, great as he was, was certainly no poet.

Is Shakespeare's Life Revealed in His Sonnets?

The desire to know more of Shakespeare's private history has led to an unceasing search in his plays for hints, without much result. He left, however, 154 sonnets—published probably against his wishes in 1609—in which many readers believe he revealed an important episode of his life. These have consequently attracted more attention than anything else he wrote except 'Hamlet'. They are among the greatest sonnets in the language, but popular curiosity about them has been largely due to their supposed autobiographical significance. They shadow forth, rather than tell, a story which, in briefest form, is this: the poet loved a younger man of noble rank, who wronged the poet by stealing the affections of a mistress and by transferring his friendship to another poet, but was forgiven.

Whether these incidents ever happened or are only a dramatic invention makes the "problem of the sonnets." This has been complicated by the attempt to discover the originals of the friend, the "dark lady," and the "rival poet." One faction tries to prove that the friend was William Herbert, Earl of Pembroke; another, Henry Wriothesley, Earl of Southampton. Others have other theories. The best opinion is that the sonnets are so impassioned and so detailed that they appear to refer to some actual history, but they cannot be proved to do so.

Shakespeare's few other non-dramatic poems have only a literary interest. They are 'Venus and Adonis' and 'The Rape of Lucrece', typical Renaissance works of gorgeous imagery, lusciousness, and pagan spirit—obviously the work of a young man; a few other sonnets, a poem or two, and the 60-odd songs scattered through the plays. These last exhibit the finest Elizabethan qualities in their spontaneity, melody, and entrancing rhythms.

Shakespeare as an Elizabethan

The era of Queen Elizabeth I (1558–1603) was the period when the English Renaissance came into full flower. In this period of transition from the Middle Ages to modern times, there was a change from an absorbing interest in heaven and an after life to an ardent interest in nature and man. It was an age of curiosity, activity, and courage. Men boldly explored the past, the earth, and their own minds.

At its best the period showed an intellectual and physical daring that produced such adventurers as Raleigh and Drake, such statesmen as the Cecils, such scholar-gentlemen as Sidney, such dreamers as Spenser, such philosophers as Bacon, such scientists as Gilbert, and such poet-psychologists as Shakespeare At its worst it was extravagant and brutal.

Its extravagance showed in its manners, dress, and speech, which were elaborate and ornate. The language was growing like a weed and made all sorts of wild growths. And yet for this very reason it was suited to poetry. Shakespeare's vocabulary was the largest employed by any English author; but its size is less remarkable than its expressiveness. It may be said that English idiom reached its peak of raciness and strength between 1600 and 1610, in the closing years of Elizabeth's reign and the early years of James I, when the King James version of the Bible was being made, when Bacon was writing his 'Essays', and when Shakespeare was composing his great tragedies.

The Elizabethans worshiped learning, but only because it made life more interesting. And they looked upon literature as only one sort of living, and a poor

substitute for action. Like the Greeks, they valued physical education as no less important than intellectual culture. A gentleman should, they thought, be able to ride, fence, hawk, and hunt; should have mastered the many dances then in vogue; and should know how to sing, play an instrument, and write verses. The age was extremely musical; indeed, it saw the beginning of modern music. The Elizabethans loved the open air, field sports, gardens, birds, and flowers. Their sports were often brutal, and their hotheadedness reminds one of the Italians they admired. One does not have to read far in Shakespeare to realize how fully, in all these respects, he was a child of his age.

Among the English middle class then, as always, sturdy morality and sobriety were combined with independence of spirit. The citizens of London were tenacious of their rights and did not hesitate to defy the court if it became too arrogant. But courtiers, citizens, and common people found common ground in their love of the stage, pageantry, and poetry. The nobles encouraged and supported the actors; they provided the processions, masques, and tournaments which the public loved to watch. The extravagance of the court was proverbial. They vied with one another to excel in dress, building, lavish entertainment, and flattery of the Queen.

The Queen as a Symbol of the Age

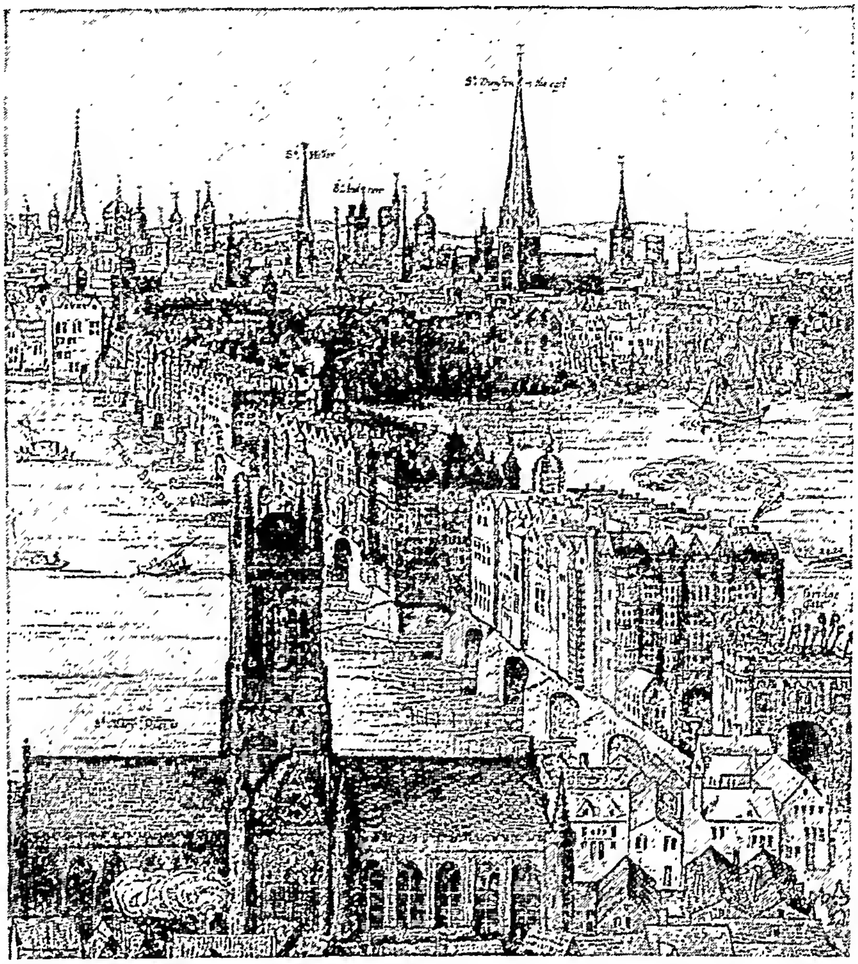
The Queen herself was the symbol of the glory of England. To her people, Elizabeth I was the embodiment of beauty and greatness. How great or little she actually was historians are not agreed, but for her people she was Gloriana, the Faerie Queene—Juno and Venus and Minerva in one. (*See* Elizabeth I, Queen of England.)

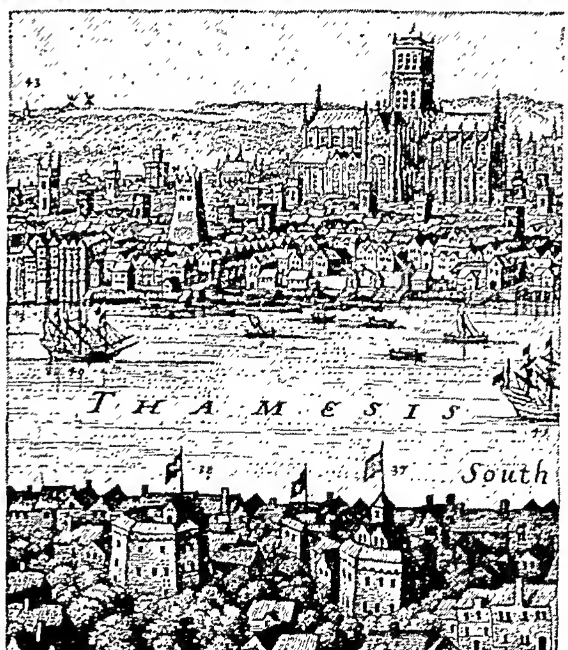
During her reign, in spite of plague and other calamities, the country grew fast in wealth and influence. Although moralists rebuked the laxity of morals, the oppression of the poor, and the greediness of the nobles, England was still Merry England. It had the best inns in Europe, the richest and most varied diet, and its people were the best clothed and housed. The Queen also typified the position of women, who were free and who, like her, conversed, jested, and even cursed as the equals of men—just as they do in Shakespeare's comedies.

The Drama in the Elizabethan Age

The defeat of the Spanish Armada in 1588 had a profound effect upon the popular spirit, convincing sober men that England was great and the populace that any Englishman could beat six Spaniards. During the decade 1590–1600, the nation became intensely interested in its own past, and the

THE LONDON OF SHAKESPEARE'S DAY





The chief theater district, Bankside, was on the south bank of the Thames. Theatergoers reached it by rowboat or by crossing London Bridge. The upper picture (engraved in 1616) shows this famous bridge and the high buildings which covered it. The lower picture (engraved 20 years later) shows Bankside in the foreground, with the Globe Theater (numbered 37) and the Bear Garden (38).

playwrights catered to this patriotism by writing chronicle or history plays—great sprawling dramas telling the stories of the English kings. Shakespeare wrote ten of them. And the same interest spread to the history of the nations of the Continent, ancient and modern.

When Shakespeare arrived in London, he found the theater and drama in a lusty condition. The love of the stage amounted to a craze, and plays were shrewdly calculated to appeal to the popular taste. The popularity of the theater resembled, in fact, that of the motion picture today. The first public playhouse had been opened a few years earlier, in 1576. The group of talented men known as the University Wits had already developed new types of plays out of old forms and had learned much about what the public wanted.

The dramatic authors of the time were practical men, bent on making a living. They might boast of their learning, but they were more eager to fill the theaters than to please the critics. The consequence was that the drama, almost from the start, was a popular art and not, as in France, a learned and classical art. Shakespeare harbored no fancy notions. He wrote his plays to be acted, not to be read. He worked with his ear close to the ground and he was quick to detect changes in popular taste. He took whatever forms were attracting attention and made them better. He borrowed his plots, perhaps to save time, and even paraphrased passages from other authors.

A theatrical author in those days was likely to be also an actor and producer. He joined a company and became its playwright, selling his manuscripts to it and retaining no personal rights in them. Revision and collaboration were common, perhaps because the demand for plays was so great that it could never be adequately supplied, and such methods saved time. The reason why no manuscripts of Shakespeare—with the possible exception of a scene of the 'Sir Thomas More'—and very few of other dramatists have survived is that plays were written, not to be printed, but to be played. They were, in fact, hardly considered literature at all.

A company of players was a cooperative organization sharing profits. Because its members had individually no legal or political rights, each company sought a patron among the rich nobles, became nominally his "servants" or "men," and received his protection. A company consisted usually of eight or ten men, who took the main rôles and employed other actors as these were needed. Boys took the female rôles, for women did not appear on the stage.

The Elizabethan Theater

The theaters were of two sorts, public and private. The former were usually round wooden structures, with three stories corresponding to the three galleries inside. The private theaters were commonly square, but of the same general design, except that they were entirely roofed over. The pit of the public theaters, corresponding to the modern orchestra, was not roofed. It had no seats and its occupants were slangily called "groundlings" because they stood on the ground. Admission to the pit was usually a penny; admission to the galleries, boxes, and stage cost more. Performances were given in the afternoon.

The main stage of the Globe Theater, for which most of Shakespeare's plays were written, was a platform about 40 feet wide projecting 27 feet into the pit, with a roof of its own. Behind it was a recessed inner stage, which could be concealed by curtains. Above the inner stage was a second inner stage, with curtains and a balcony; and above that, a music room, the front of which could be used for dramatic action. On top of the stage roof was a structure called the "huts," with hoists for raising and lowering actors and properties. On days of performances a flag was flown from a turret above the huts.

It is often said that the Elizabethans used no scenery, but there is reason to believe that their stage was by no means bare. We know that they used "heavy properties" and hangings and that their settings were often elaborate. Their costumes, which were as a rule in the fashion of the time, were sumptuous.

Exactly how the stage was used is still a matter of debate. It is obvious, however, that in general the outer stage was used for outdoor scenes and mass effects; the inner, for interiors and intimate scenes and as a background; the upper, for elevated scenes, as at windows or on walls. All three stages could be used in any combination.

Influence on Shakespeare's Methods

This stage affected Shakespeare's technique in various ways. Perhaps the most important is that it was so free or "plastic" that it permitted a rapidity of changes and of action hardly possible on our stage. 'Antony and Cleopatra', for example, has more than 40 scenes. Another is that the outer stage, projecting into the audience, encouraged oratory; this suggests a reason for the long and impassioned speeches so usual in his dramas. The absence of women actors made the disguises of women as men seem less unnatural than we find them. The absence of stage lighting and of a roof accounts for the multitude of speeches suggesting time, season, and weather. There are more than 40 such references in 'Macbeth'. The intimacy of actor and audience, the mixture of classes in the theater, and the proximity of the "groundlings" to the stage explain why nearly all the plays contain scenes and speeches designed to appeal to all sorts of people—from horseplay to philosophy, from grossness to exquisite poetry.

For this theater Shakespeare wrote at least 37 plays. The chief sources from which he took his plots were Plutarch's 'Parallel Lives of Illustrious Men', Raphael Holinshed's 'Chronicles of England, Scotland, and Ireland', and certain Italian *novelle*, or short tales. A few plays he borrowed from older dramas, and one or two from English stories. But what he did with his borrowings is more important than his borrowing. In brief, if his original gave him what he needed, he used it closely; if not, he changed it, and

his changes are a chief mark of his ability as a playwright.

Shakespeare as Dramatist

Thus far, we have been concerned with the facts about Shakespeare. But when we turn to a consideration of his place in literature, such facts have little to do with our appreciation. Shakespeare wrote his plays to give entertainment; and it is possible to kill our enjoyment of his art by too much attention to his life, his times, and the problems of his text. He can be enjoyed at home or in the playhouse without our knowing any of these things.

There are difficulties, however, in the way of this enjoyment. He wrote 300 years ago and his language is naturally somewhat different from ours, containing words we may not know. Besides, he wrote in verse, and verse permits an imaginative use of words that taxes the mind of an unimaginative reader. His plays are, moreover, often fanciful; and matter-of-fact persons, used to modern realism, are offended by their improbability. For all these reasons, readers may find him difficult. But perhaps the worst handicap to enjoyment is the notion that he is a "classic," a writer to be approached with awe, to read whom one has to be learned and solemn.

Reading the Plays for Enjoyment

The way to escape this last difficulty is to remember that Shakespeare wrote his plays for the public, many of whom were less intelligent and less educated than we. They looked upon him as an amusing, exciting, and lovable entertainer, rather than as a great poet. If we will but try to read him as they listened to him, for excitement and enjoyment, we shall lose self-consciousness and most of the surface difficulties will vanish.

THE STAGE OF THE GLOBE PLAYHOUSE

This reconstruction by John C. Adams shows a typical Elizabethan stage with its four-story stagehouse. Action took place mostly on the first two levels.

We must never lose sight of the fact that the plays were written to be performed, not to be read. It is therefore important to see exactly what happens in the plays and why. The more we study his plots, the more we realize that Shakespeare is a masterly playwright. He not only constructed his plays with care but seldom admitted a speech that did not forward the action or develop character or aid the imagination of the spectator. It is well to read the plays twice; first rapidly for the story, and again for details and fuller understanding. It really pays, too, to study his language, because it is truly wonderful in expressiveness and concentrated meaning. An edition that has good explanatory notes is for this reason an aid to the enjoyment of the plays.

As for the improbability of his plots, we must remember that he belonged to an age which was romantic and poetic. People had not lost the power of making believe. They did not go to the theater to see scenes like those of real life, but to be carried away into other times and places or into a land of fancy. Today the imaginative reader loves him for the same reason. There were really no such places as his Bohemia or Illyria or Forest of Arden, though the names were real. He has never been equaled in the invention of supernatural creatures—ghosts, witches, and fairies.

And yet Shakespeare's art, like all great art, is realistic in the sense of being true to life. However fantastic his plots may seem, as in 'Lear', 'Midsummer Night's Dream', and 'The Tempest', they are at bottom powerfully and eternally true. However unusual his characters may seem at first, they are often more revealing and instructive than persons in

real life. His Hamlet is more famous than any but a few real persons; his Brutus, Cleopatra, and Macbeth have supplanted in our minds the real men and women they represent.

Characters That Will Live Forever

For the general reader the greatest fascination lies no doubt in his plots and characters. No one has ever excelled him in creating persons who seem alive and three-dimensional, who live in the mind as warmly as one's intimate friends. His greatest glory is, of course, his portrayal of his great heroes, and yet his ability to make minor characters live is quite as remarkable. As a test of his powers of portrayal one might take the fact that he drew more than twenty young women, all of about the same age, the same station in life, and the same social background, and yet made them as different and as lovable as any twenty girls in real life. And the same might be said of his elderly women, men of action, churchmen, kings and villains, dreamers, fools, and bumpkins.

To his contemporaries, Shakespeare was only one of half a hundred playwrights who provided excitement and entertainment. Of these, Ben Jonson, George Chapman, Thomas Dekker, Thomas Heywood, John Webster, John Ford, Philip Massinger, Thomas Middleton, John Fletcher, or Francis Beaumont may at times have seemed his equals. For he played a part in a very vigorous literary movement, so rich in talent that any one member might be obscured. This fact, however, makes all the more notable his gradual surpassing of his contemporaries and their decline in reputation. Excellent dramatists though they were, they have all but disappeared from the stage and are read chiefly by students who wish to acquaint themselves with the literary background of Shakespeare.

If we seek the reason for this enduring appeal of Shakespeare, we shall find that both his knowledge of humanity and his mastery of the art of poetry were greater than those of any other man. But just as the world took time fully to realize his greatness, so must we. Many men spend their lives reading and studying him, for he is inexhaustible. And yet not much is gained by assuming, as too many do, an attitude of awe and worship toward him. The best way to approach him is the one he would have liked: as a wise, humorous, friendly person, who loved mankind, nature, and poetry.

His Poetic Excellence

As for his poetry itself, it is hard to say anything about it in a few words. One fact is suggestive: no other writer in the world is so quotable or so often quoted. His ability to express thought and feeling in words of beauty or power is unexcelled. There was apparently nothing that he could not fit to words or fit words to. And in all the technical skills of the poet —rhythm, sound, image, and metaphor—he remains the greatest of craftsmen. And, finally, his range is immense, extending from the wildest word play to the sublimest eloquence, from the homeliest speech of common men to the subtlest language of the philosopher.

The meter of his plays is the unrhymed iambic pentameter called "blank verse." This was first used in Italy. It was adopted by English poets in the reign of Henry VIII and developed as a dramatic verse-form by the University Wits, especially Marlowe. From these, Shakespeare took it and perfected it. He, with Milton, was mainly responsible for making it the greatest meter in English. Blank verse is finely adapted for use in poetic drama, because it is far enough removed from prose without being too far removed. Rhymed verse seems too monotonous and artificial; blank verse is more ordered, swift, and noble than prose and yet is at the same time so flexible that it seems almost as natural as prose, if it is written by a master. (*See also* Poetry.)

Examples of His Art

To gain an impression of Shakespeare's power and variety, read such passages as Prospero's speech in 'The Tempest', Act IV, Scene i:

> Our revels now are ended. These our actors,
> As I foretold you, were all spirits, and
> Are melted into air, into thin air;
> And, like the baseless fabric of this vision,
> The cloud-capp'd towers, the gorgeous palaces,
> The solemn temples, the great globe itself,
> Yea, all which it inherit, shall dissolve
> And, like this insubstantial pageant faded,
> Leave not a rack behind. We are such stuff
> As dreams are made on, and our little life
> Is rounded with a sleep.

And then Lorenzo's speech in the last act of 'The Merchant of Venice':

> How sweet the moonlight sleeps upon this bank!
> Here will we sit and let the sounds of music
> Creep in our ears. Soft stillness and the night
> Become the touches of sweet harmony.
> Sit, Jessica. Look how the floor of heaven
> Is thick inlaid with patines of bright gold.
> There's not the smallest orb which thou behold'st
> But in his motion like an angel sings,
> Still quiring to the young-ey'd cherubims;
> Such harmony is in immortal souls;
> But whilst this muddy vesture of decay
> Doth grossly close it in, we cannot hear it.

Then compare other great passages, such as Shylock's "Signior Antonio, many a time and oft," Mercutio's "O, then, I see Queen Mab hath been with you," Richard II's "No matter where; of comfort no man speak," Hamlet's "How all occasions do inform against me," Claudio's (in 'Measure for Measure') "Ay, but to die, and go we know not where," Othello's "Soft you, a word or two before you go," Jaques's "A fool, a fool! I met a fool i' the forest," Macbeth's "We have scotch'd the snake, not kill'd it," and Cleopatra's "Give me my robe, put on my crown."

Note how each speech is characteristic of the speaker and of no one else; each is intensely moving; each is supreme in rhythmical flow and force; and yet all are in the same basic pattern. To make such a comparison is a fine exercise in taste and feeling. To learn these passages by heart is to provide oneself with a friendly and familiar joy in great speech for the rest of one's life.

The Wonder of Our Stage

Soul of the age!
The applause, delight, the wonder of our stage!
My Shakspere, rise! I will not lodge thee by
Chaucer, or Spenser, or bid Beaumont lie
A little further, to make thee a room:
Thou art a monument without a tomb,
And art alive still while thy book doth live
And we have wits to read and praise to give.

—BEN JONSON (1573?–1637)

Great Heir of Fame

What needs my Shakspere for his honored bones
The labor of an age in pilèd stones?
Or that his hallowed relics should be hid
Under a star-ypointing pyramid?
Dear son of memory, great heir of fame,
What need'st thou such weak witness of thy name?

—JOHN MILTON (1608–1674)

Needed Not the Spectacles of Books

He was the man who of all modern, and perhaps ancient poets, had the largest and most comprehensive soul. All the images of nature were still present to him, and he drew them, not laboriously, but luckily; when he describes anything, you more than see it, you feel it too. Those who accuse him to have wanted learning, give him the greater commendation: he was naturally learned; he needed not the spectacles of books to read nature; he looked inwards, and found her there.

—JOHN DRYDEN (1631–1700)

Nature Speaks through Him

If ever any author deserved the name of an original, it was Shakespeare. . . . The poetry of Shakespeare was inspiration indeed: he is not so much an imitator, as an instrument, of Nature; and 'tis not so just to say that he speaks from her, as that she speaks through him . . . every single character in Shakespeare is as much an individual as those in life itself.

—ALEXANDER POPE (1688–1744)

A Forest of Endless Diversity

The work of a correct and regular writer is a garden accurately formed and diligently planted, varied with shades and scented with flowers. The composition of Shakespeare is a forest, in which oaks extend their branches, and pines tower in the air, interspersed sometimes with weeds and brambles, and sometimes giving shelter to myrtles and to roses; filling the eye with awful pomp, and gratifying the mind with endless diversity.

—SAMUEL JOHNSON (1709–1784)

How He Affected Goethe

I do not remember that any book, or person, or event in my life ever produced so great an effect upon me as Shakespeare's plays. They seem to be the work of some heavenly genius.

—JOHANN WOLFGANG GOETHE (1749–1832)

A Royal Stage

The stage in Shakespeare's time was a naked room with a blanket for a curtain, but he made it a field for monarchs.

—SAMUEL TAYLOR COLERIDGE (1772–1834)

Nobility of His Teachings

Shakespeare strengthens virtue, kills selfish and mercenary thoughts, induces sweet honourable actions and ideas, teaches benignity, courtesy, generosity, and humanity.

—CHARLES LAMB (1775–1834)

England's Proudest Boast

In spite of the sad state Hero-worship now lies in, consider what this Shakspeare has actually become among us. Which Englishmen we ever made, in this land of ours, which million of Englishmen, would we not give-up rather than the Stratford Peasant? . . . He is the grandest thing we have yet done. For our honour among foreign nations, as an ornament to our English Household, what item is there that we would not surrender rather than him? Consider now, if they asked us, Will you give-up your Indian Empire or your Shakspeare, you English; never have had any Indian Empire, or never have had any Shakspeare? Really it were a grave question. Official persons would answer doubtless in official language; but we, for our part too, should not we be forced to answer: Indian Empire, or no Indian Empire; we cannot do without Shakspeare! Indian Empire will go, at any rate, some day; but this Shakspeare does not go, he lasts forever with us; we cannot give-up our Shakspeare!

—THOMAS CARLYLE (1795–1881)

Variety of His Characters

Highest among those who have exhibited human nature stands Shakespeare. His variety is like the variety of nature, endless diversity, scarcely any monstrosity. The characters of which he has given us an impression, as vivid as that which we receive from the characters of our own associates, are to be reckoned by scores. Yet in all these scores hardly one character is to be found which deviates widely from the common standard and which we should call very eccentric if we met it in real life. The silly notion that every man has one ruling passion, and that this clue once known unravels all the mysteries of his conduct, finds no countenance in the plays of Shakespeare. There man appears as he is, made up of a crowd of passions, which contend for the mastery over him and govern him in turn. . . . Admirable as he is in all parts of his art, we most admire him for this—that while he has left us a greater number of striking portraits than all other dramatists put together, he has scarcely left us a single caricature.

—THOMAS BABINGTON MACAULAY (1800–1859)

A Treasure for All Time

. . . a thousand years hence a world of new readers will possess a whole library of new books, as we ourselves do, in these volumes old already.

—NATHANIEL HAWTHORNE (1804–1864)

Practical Christianity

I have derived more practical Christianity from reading Shakespeare's plays and seeing them enacted than from any sermon I ever heard preached.

—CHARLES KINGSLEY (1819–1875)

Shakespeare's faults are many, but they are the faults of greatness. His love of words leads him sometimes to indulge in rant and bombast, puns and quibbles; and haste betrays him occasionally into writing nonsense. His less important characters sometimes talk affectedly or tastelessly. Like others of his time, he can be coarse and even gross, and he occasionally shocks the reader by his callousness. But most of his faults can be counted as natural to a writer of his period, which was not ashamed of our animal nature, though at the same time it was in no doubt about our divinity.

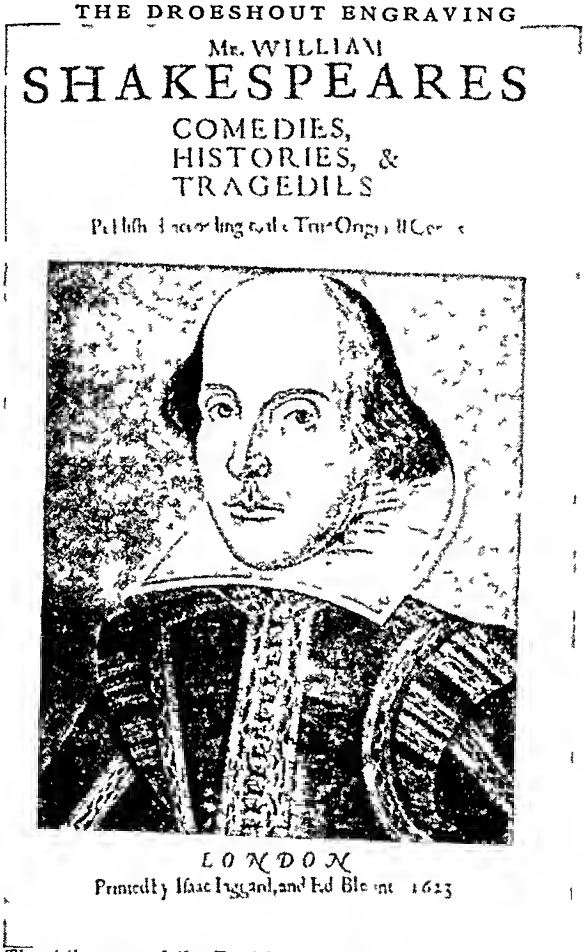
How the Plays Came Down to Us

We owe a great debt to the scholars who for more than 200 years have worked over the text of the plays. The reason why they have had to do so is mainly that the plays were badly printed and no original manuscripts of them survive.

In Shakespeare's day plays, as a rule, were not printed under the author's supervision. In fact, when a playwright sold a play to his company, he evidently lost all rights in it and could not sell it to a publisher without the company's consent. When a play was no longer in demand on the stage, however, the players would sometimes make a little money by selling the manuscript, for plays were eagerly read by the Elizabethan public. During plague years, when the theaters were closed, and in other times of financial difficulty, this was especially apt to occur. Sometimes, too, plays were taken down in shorthand, or a dismissed actor would write down the play as well as he could remember it and sell it to a stationer.

About half of the plays of Shakespeare appeared in his lifetime in small, cheap pamphlets called quartos. Most of these were printed from fairly accurate manuscripts, but a few were in garbled form. In 1623, however, seven years after the death of Shakespeare, his collected plays were published in a large, expensive volume called the First Folio. This contains all his plays (except two plays of which he wrote only part —'Pericles' and 'The Two Noble Kinsmen'), as well as the first engraved portrait of Shakespeare.

THE DROESHOUT ENGRAVING



This title page of the First Folio contains the only certainly authentic likeness of Shakespeare, except the bust on his monument. (Folger Shakespeare Library print.)

This edition was authorized by the author's old comrades, the King's Players, and consequently has great authority in determining what he wrote. Some of the plays in it were printed from the "good" quartos, and some from manuscripts taken from the playhouse. Some of these manuscripts, we have every reason to believe, were in Shakespeare's own handwriting. Others were later copies. Still others, like that from which 'Macbeth' was printed, were manuscripts which a later dramatist had revised.

By studying the language, stagecraft, handwriting, and printing of the period, and by carefully examining and comparing the different editions, editors of Shakespeare have been ascertaining, as nearly as they can, what Shakespeare actually wrote. They have modernized the spelling and punctuation of his plays, supplied them with stage directions, explained difficult passages, and made the works of the poet easier for the modern reader to understand and enjoy.

Scholars and Their "Detective Work"

But along with the stupendous labor of making a good text has gone another —that of determining the chronology or dates of the plays, to help us see the growth of the poet's genius. For about half of the plays we have no positive indication of the date of composition. The critical labor involved has consisted of an exhaustive examination of the plays themselves for possible indications in them concerning the dates of their composition, a search for evidence on this subject in other books, and the attempt to relate the author's literary work to other events in his life.

The methods of ascertaining the order of the plays are a kind of fascinating detective work, having to do with clues, deductions, shrewd reasoning, and weighing of evidence, external and internal. External evidence consists of actual references in other books; internal, of allusions in the plays to external events, of verse tests, and of a study of the poet's imagery and figures of speech.

The verse tests were suggested by the fact that a poet, in mastering a verse form, such as blank verse,

naturally becomes more and more skilful. It was long ago noticed, for example, that in plays known to be early, Shakespeare used little prose, much rhyme, and certain types of rhythmical and metrical regularity; but that, as he grew older, he used more prose, less rhyme, and greater freedom and variety in rhythm and meter. By tabulating such technical facts in all the plays, scholars have obtained evidence which suggests the dates of plays about which external evidence is lacking. We are thus fairly well assured of the order in which the plays were written. This order is indicated in the accompanying table.

How Critics Rank the Plays

A recent investigation indicates that nine plays are most read in American high schools, as follows, in descending order: 'Macbeth', 'As You Like It', 'Julius Caesar', 'Hamlet', 'The Merchant of Venice', 'A Midsummer Night's Dream', 'Romeo and Juliet', 'The Tempest', and 'Twelfth Night'. These are all among the finest, and the experience of teachers suggests that they are good ones to begin with.

For the sake of providing a general view of all the plays, however, they are arranged below in numbered groups indicating the order of excellence. This ranking of the plays is the result of three centuries of appraisal, but there is still no unanimity of opinion concerning it. Individual critics have ranked each of the great tragedies as the greatest, and some have considered 'Antony and Cleopatra' and 'Coriolanus' as great as the first four. Similar differences of opinion exist regarding the great comedies. Nevertheless, the arrangement is interesting and instructive.

TRAGEDIES: (1) 'Hamlet', 'Macbeth', 'King Lear', 'Othello'; (2) 'Antony and Cleopatra', 'Coriolanus', 'Romeo and Juliet', 'Julius Caesar'; (3) 'Richard II', 'Richard III', 'Timon of Athens'; (4) 'King John', 'Titus Andronicus', 'Henry VI'.

COMEDIES: (1) 'The Tempest', 'As You Like It', 'The Winter's Tale', 'The Merchant of Venice', 'Twelfth Night', 'Much Ado about Nothing', 'Cymbeline', 'A Midsummer Night's Dream'; (2) 'The Merry Wives of Windsor', 'The Taming of the Shrew', 'Two Gentlemen of Verona', 'All's Well That Ends Well', 'A Comedy of Errors', 'Pericles', Love's Labour's Lost', 'Two Noble Kinsmen'.

HISTORIES: (1) 'Henry IV' Parts 1 and 2, 'Henry V', 'Richard II', 'Richard III', 'Henry VIII'; (2) 'King John', 'Henry VI' Parts 2 and 3, 'Henry VI' Part 1.

SERIOUS PLAYS OR "BITTER COMEDIES": 'Measure for Measure', 'Troilus and Cressida' (remarkable plays, but their reading can wait).

CHRONOLOGY OF THE PLAYS

NOTE: The approximate date when Shakespeare wrote each play is given before the title, the date of first printing after the title. Many of these dates are in dispute, and scholars differ about some of them by as much as ten years. The letters (C), (H), and (T) show whether the play is a comedy, historical drama, or tragedy.

FIRST PERIOD (1590–1594)
APPRENTICESHIP

1590	The Comedy of Errors (C) *1623*
1591	Two Gentlemen of Verona (C) *1623*
1592	Henry VI, Parts 1, 2, 3 (H or T) *1623**
1593	Titus Andronicus (T) *1594*
	Love's Labour's Lost (C) *1598*
1594	Richard III (H or T) *1597*

*In a mutilated version, 'Henry VI' Part 2 was published in 1594 and Part 3 in 1595.

SECOND PERIOD (1595–1600)
GREAT COMEDIES AND HISTORIES

1595	A Midsummer Night's Dream (C) *1600*
	Richard II (H or T) *1597*
1596	Romeo and Juliet (T) *1597*
	The Merchant of Venice (C) *1600*
	King John (H or T) *1623*
1597	Henry IV, Part 1 (H) *1598*
	Part 2 (H) *1600*
1598	The Taming of the Shrew (C) *1607*
	Much Ado about Nothing (C) *1600*
1599	Henry V (H) *1600*
	The Merry Wives of Windsor (C) *1602*
	Julius Caesar (T) *1623*
1600	As You Like It (C) *1623*
	Twelfth Night (C) *1623*

THIRD PERIOD (1601–1608)
GREAT TRAGEDIES AND BITTER COMEDIES

1601	Hamlet (T) (pirated edition) *1603*
	(good edition) *1604* or *1605*
1602	All's Well That Ends Well (C) *1623*
	Troilus and Cressida (C) *1609*
1604	Measure for Measure (C) *1623*
	Othello (T) *1622*
1605	King Lear (T) *1608*
1606	Timon of Athens (T) *1623*
	Macbeth (T) *1623*
1607	Antony and Cleopatra (T) *1623*
	*Pericles, Prince of Tyre (C) *1609*
1608	Coriolanus (T) *1623*

*Perhaps a collaboration.

FOURTH PERIOD (1609–1613)
TRAGICOMEDIES

1609	Cymbeline (C) *1623*
1610	The Winter's Tale (C) *1623*
	The Tempest (C) *1623*
1613	*Henry VIII (H) *1623*
	*Two Noble Kinsmen (C) *1634*

*Perhaps a collaboration.

Tests of Greatness

What we mean by greatness is a very complex question. It is probably best answered in the end by feeling. 'King Lear' has a plot that is all but silly and contains faults of taste obvious enough, and yet it has been generally accounted one of the greatest of the tragedies. The reason is that it contains sublime poetry, profound experience, scenes of unutterable pathos, and personages conceived with a grandeur almost unparalleled; and it is besides so complex in detail and yet so grandly simple as a whole that it reminds one of a Beethoven symphony. It remains in the mind like a great natural upheaval—an earthquake or a tornado. It is some such vague but powerful feeling about each of the tragedies, rather than any logical reasoning, that makes experienced critics decide what its rank is. And it is some equally general feeling of richness that decides the rank of the comedies.

The inexperienced reader has to take such judgments on faith. He will read the plays for their stories, persons, and poetic passages, and he may like an inferior play better than a great one. There is nothing to worry about in this. The honest thing is to be true to one's own tastes, and never to pretend to like what one does not. In time, if one continues to read and reread, the reasons why one play is considered better than another will appear.

Shakespeare's Four Periods

In quick review of Shakespeare's entire output, we can say that during his period of apprenticeship—be-

A FIT RESTING PLACE FOR "THE SWAN OF AVON"

Reflected in the placid waters of the Avon River at Stratford is the tower of Trinity Church where Shakespeare lies buried. The thousands who visit this spot every year carry away unforgettable memories of its quiet beauty.

tween his 24th and 30th years—he was learning his craft. He imitated Roman comedy and tragedy and the styles of Lyly, Kyd, Greene, Peele, and Marlowe—his immediate predecessors—and possibly collaborated with Marlowe and others. Since Senecan tragedy or the "tragedy of blood" was in vogue, Shakespeare wrote plays in this style; as he wrote chronicle or history plays when these became fashionable.

With 'Romeo and Juliet' and 'The Merchant of Venice', he had mastered the art of both tragedy and comedy, and with 'Henry IV', the art of history. He essayed the comedy of contemporary local manners only once and then probably without much heart, in 'The Merry Wives of Windsor', for his favorite style was that of romantic comedy. During this second period he shows the ease, power, and consummate mastery of maturity, and the plays are in general sunny, full of fun and joyous poetry.

With Hamlet, about 1601, his tragic period begins and for eight years his thoughts become darker as he probes the problem of evil in the world, at times reaching an almost desperate pessimism. Even the comedies of this time are bitter.

In the last period, cultivating a new form originated by other dramatists, the tragicomedy or dramatic romance, he writes plays of sober coloring but in a mood of reconciliation with life. 'The Tempest' is perhaps the most beautiful and serene of all his plays. At the very end he appears to have returned to collaboration, working with John Fletcher or another, on such plays as 'Henry VIII' and 'Two Noble Kinsmen'—perhaps because he was growing tired.

As we look back over this tremendous accomplishment and try to explain Shakespeare's popularity, not only in England and America, but in other civilized nations, we can only say that he has a magic of speech and fancy which we can feel but not describe.

Some Reasons for His Popularity

His charm is compounded of the "shaping power" of imagination, an incomparable witchery of words, an almost godlike tolerance and sympathy, and a prevailing healthiness of mind. No one else has the variety which has won for him the name of "myriad-minded." No one else has his warmth of humanity combined with uncompromising vision of human villainy and reverence for human heroism.

He recognizes evil, but believes that man can overcome it. As he says, "we are mixtures of good and evil"; and the astonishing reality of his people lies partly in the fact that, like real people, they can be great and yet foolish, bad and yet likable, good and yet faulty. He appears really to have believed that "it takes all kinds of people to make a world," and to have found even fools, knaves, and madmen so fascinating that he would not have voted them out of existence if he could.

Solemn folk have therefore accused him of having no convictions, no social conscience, no general beliefs, no philosophy. They forget that he had something rarer and more precious; an infinite tolerance and charity. We do not know what his religion was, but we must be blind not to see that he loved men and believed in their capacity for nobleness. His greatest creations are painted larger than life and have a super-

human energy and grandeur, but they are in essence symbols of mankind in its greatest passions and powers, whether thinking or feeling, whether good or evil. (For titles of plays treated elsewhere, *see* **Shakespeare** in FACT-INDEX at the end of this volume.)

The Great Shakespeare Collections

The number of books about Shakespeare is stupendous. If it were possible to assemble them all in one place, they would make an array of thousands. The greatest collections are in the Folger Shakespeare Library, Washington, D. C.; the Henry E. Huntington Library, San Marino, Calif.; the British Museum, London; and the Bodleian Library, Oxford University. The Folger (the name is pronounced to rhyme with "soldier"), the greatest of all, was assembled by Henry Clay Folger and bequeathed by him to the trustees of Amherst College to be administered for the use of the American people forever. He provided a $2,000,000 marble building in Washington, which was opened in 1932, and endowed the library for growth and upkeep. The collection consists of books, manuscripts, playbills, prints, paintings, and other materials. Though called a Shakespeare library, it attempts to gather all the books printed in England before 1641, and covers every aspect of intellectual activity from the beginning of the Renaissance to the Commonwealth.

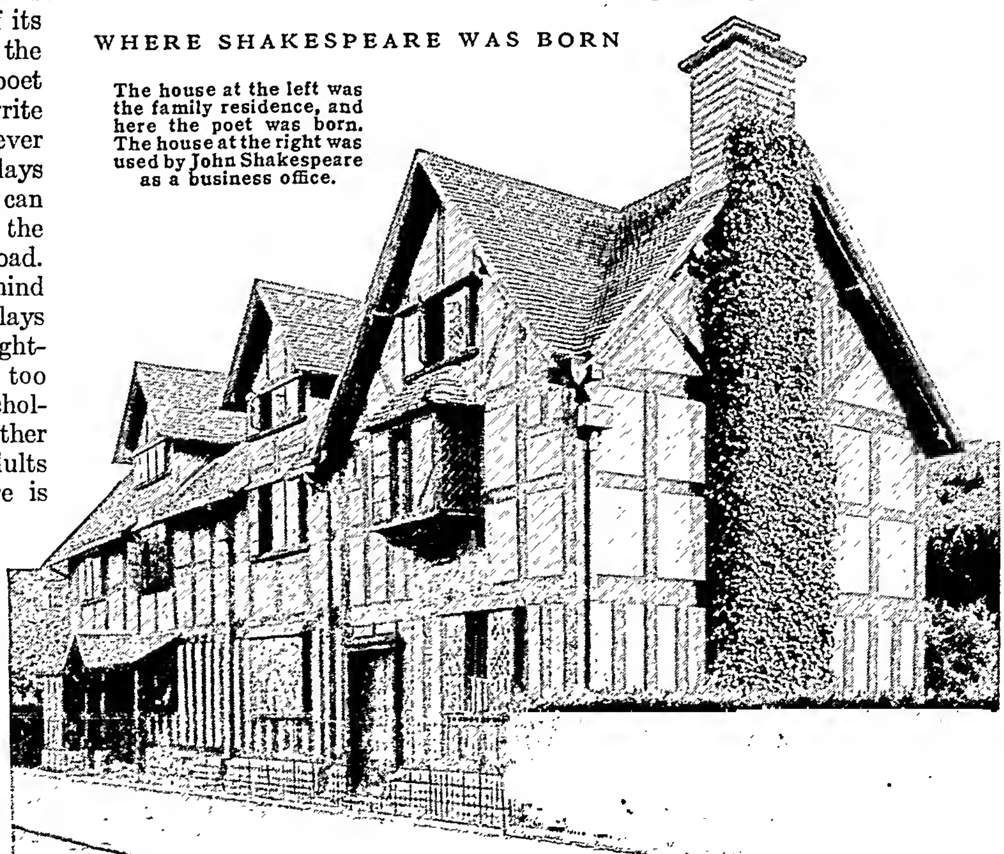
Books About Shakespeare and His Times

Countless children have first become acquainted with Shakespeare through the 'Tales from Shakespear' of Charles and Mary Lamb. This book is a classic in its own right because of its charming simplicity and the enlightened love of the poet which made its authors write it. Its narratives can never take the place of the plays themselves, but they can lead young readers to the plays along a pleasant road. They serve also to remind older readers that the plays are really a kind of delightful story-telling—a fact too often overlooked by scholars and critics. Another child's book which adults can read with pleasure is John Bennett's 'Master Skylark', which gives an interesting picture of Shakespeare's time. Charles Norman's 'The Playmaker of Avon' is a delightful biography for the young reader. One of Sir Arthur Quiller-Couch's short stories, 'Shakespeare's Christmas', is worth looking up for an amusing narrative of the moving of the Globe Theater from Shoreditch to the Bankside.

Few of us can visit the great libraries, but we can find a good substitute in the 'New Variorum Shakespeare', which contains the gist of many books. This was begun by Horace Howard Furness (1832–1912), continued by his son, and later came under the editorship of Joseph Q. Adams. The word "variorum" means that this edition gives all important variations of text from the original quartos and folios down. But this feature of the edition is to most readers the least interesting. They will prefer the footnotes, giving summaries of the discussion of textual difficulties, and the appendixes in which are reprinted the sources of the plays, opinions of English and foreign critics, records of acting, costuming, and staging, a bibliography, and many other matters. There is no better way to gain some impression of the talent and learning (and, sadly enough, the stupidity) that have been expended upon the plays than by leafing over one of the volumes.

Most good school editions give all the information necessary to intelligent reading. Among the numerous short introductions that are both useful and interesting are 'Know Your Shakespeare' by John Calvin Metcalf and 'Shakespeare: the Man and His Stage' by E. A. G. Lamborn and G. B. Harrison. The latter has excellent pictures. A larger book of similar type is 'Facts about Shakespeare' by W. A. Neilson and

WHERE SHAKESPEARE WAS BORN



The house at the left was the family residence, and here the poet was born. The house at the right was used by John Shakespeare as a business office.

COTTAGE OF ANNE HATHAWAY, SHAKESPEARE'S WIFE

In the village of Shottery about a mile west of Stratford stands this thatched cottage, famous as the birthplace of Anne Hathaway. It is preserved as a museum and is filled with furniture, ornaments, and utensils of the kind used in Shakespeare's day.

A. H. Thorndike. Hazelton Spencer's 'The Art and Life of William Shakespeare' summarizes recently discovered facts about the bard and his times and gives a critical appreciation of each play. Hardin Craig's 'Interpretation of Shakespeare' discusses the sonnets and longer poems as well as the plays.

Some readable books about the Elizabethan period are: 'Life in Elizabethan Days' by W. S. Davis; 'Life and Work of the People of England: A Pictorial Record from Contemporary Sources: Vol. IV—Sixteenth Century' by Dorothy Hartley; 'Illustrated English Social History: Vol. II, Age of Shakespeare and the Stuart Period' by G. M. Trevelyan; and 'The England of Elizabeth' by A. L. Rowse. A. H. Thorndike's 'Shakespeare's Theatre' is lively and accurate.

Of lives of Shakespeare, Sir Sidney Lee's is scholarly but out of print. Sir Edmund Chambers' is the most complete and authoritative, but intended for scholars; and Joseph Quincy Adams' is the most readable. Among the many biographies which combine fact with imagination, J. D. Wilson's 'The Essential Shakespeare' is particularly interesting concerning the poet's youth and his London. Marchette Chute's 'Shakespeare of London' is based on careful research, using documentary evidence dated no later than 1642. It emphasizes Shakespeare's career as an actor in London.

Books of Criticism and Appreciation

Small books of appreciation and criticism, all calculated to make even indifferent readers interested, are 'William Shakespeare' by John Masefield; 'On Reading Shakespeare', by Logan Pearsall Smith; and 'Prefaces to Shakespeare', by Harley Granville-Barker. Mark Van Doren's 'Shakespeare' is notable for its exclusive attention to the poetry of the plays 'Characters of Shakespeare's Plays' by William Hazlitt and 'Backgrounds of Shakespeare's Plays' by Karl Julius Holzknecht are thoughtful studies.

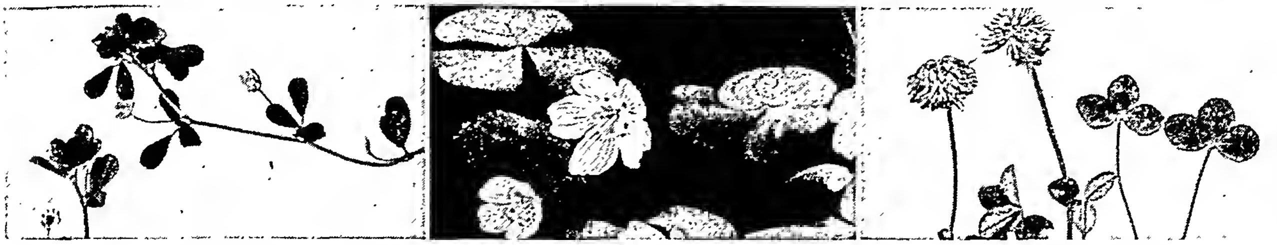
Sir Sidney Lee's 'Stratford-on-Avon' is the most interesting historical account of the town and G. B. Harrison's 'An Elizabethan Journal' (3 vols.), giving excerpts from contemporary books and broadsides, is fascinating to dip into, but both are out of print.

A. C. Bradley's 'Shakespearean Tragedy' and 'Oxford Lectures on Poetry'; A. T. Quiller-Couch's 'Shakespeare's Workmanship'; H. B. Charlton's 'Shakespearian Tragedy'; and T. M. Parrott's 'Shakespearean Comedy' are useful for advanced readers. 'Shakespeare and the Nature of Man' by Theodore Spencer is the printed version of his Lowell Lectures delivered in Boston in 1942.

For the history of the plays on the stage, Sir Edmund K. Chambers' 'The Elizabethan Stage' (4 vols.), is authoritative and scholarly. Younger readers as well as adults will enjoy the delightful 'Shakespeare without Tears' by Margaret Webster; 'Shakespeare and the Players' by C. Walter Hodges; and Marchette Chute's 'Introduction to Shakespeare'.

Standard reference books which would be of use in any school library are: 'Pronouncing Dictionary of Shakespearean Proper Names' by Theodora U. Irvine; 'A Shakespeare Glossary', by C. T. Onions; and 'Home Book of Shakespeare Quotations', by B. E. Stevenson. An extensive bibliography is given in the 'Cambridge History of English Literature'.

EACH OF THESE HAS BEEN CALLED THE TRUE IRISH SHAMROCK



Hop Clover Wood Sorrel White Clover

SHAMROCK. "You tell us that there are three gods, and yet one," wonderingly said the natives of Ireland when Saint Patrick was preaching the gospel to them 1,500 years ago. "How can that be?"

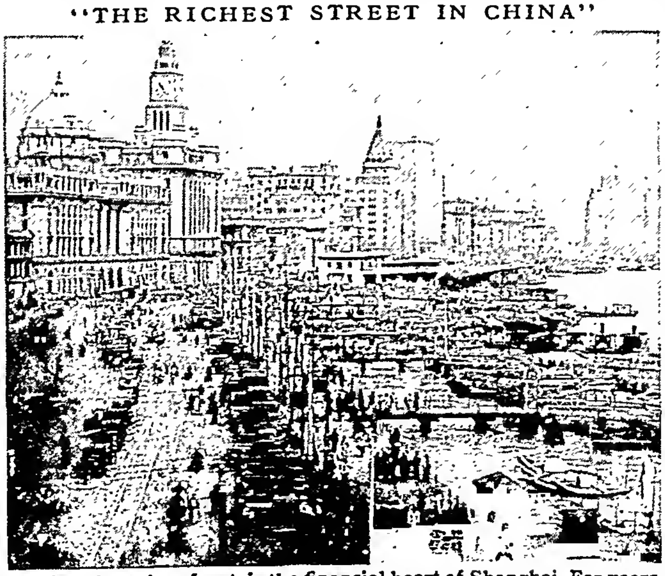
For answer the saint bent over and plucked a shamrock growing at his feet. "Do you not see," he said, "how in this wild flower three leaves are united on one stalk, and will you not then believe what I tell you, that there are indeed three Persons and yet one God?"

Historians have relegated many stories about Saint Patrick to the realm of myth, but the shamrock remains the emblem of Ireland, proudly worn by Irishmen the world over on Saint Patrick's Day (March 17). Several plants claim the honor of being the original shamrock (in Irish *seamrog*, meaning "three-leaved"). One of these is the hop clover (*Trifolium dubium*) or lesser yellow trefoil. This resembles white clover, but has yellow flowers and blue-green leaflets. Others are the wood sorrel or oxalis (*Oxalis acetosella*) and the white clover (*Trifolium repens*).

SHANGHAI, CHINA. Today Shanghai is the chief port of China and in normal times of much of the Far East. The city won this prominence as a great port because of its geographical position. It lies on the mud flats of the Whangpoo River, about 12 miles from the mouth of the mighty Yangtze River. In the Yangtze Valley lives nearly half the population of China. Shanghai is the natural distributing center for coastal trade. Moreover, by sea it lies about the same distance westward from New York and eastward from London.

Until 1843, however, Shanghai was a mere fishing village. But the British appreciated its advantages and they forced China to make the village a "treaty port." The concession also allowed British traders to build a self-governing settlement. French and United States traders soon built others. In 1863 the Americans and British merged their holdings to form the International Settlement. The three nations made Shanghai the cornerstone of foreign power in East Asia for many years.

"THE RICHEST STREET IN CHINA"



The Bund, or river front, is the financial heart of Shanghai. For years it was part of the International Settlement. But shortly after the second World War the foreign powers returned it to China.

Chinese crowded into the new city and made it a sprawling metropolis. It consisted of the foreign settlements; the old village, later called Native City; Nantao, adjoining Native City; Pootung, east of the river; and Chapei, to the north. The foreign concessions were clean and modern, but a very large part of the city remained a teeming jumble of narrow, twisted streets and poverty-ridden tenements and huts. Many thousands lived in squat sampans (boats) along Soochow Creek, which winds through the city and empties into the Whangpoo.

The heart of the city is the harbor. Engineers must work almost constantly to remove silt deposits left by the Whangpoo. Here ships load and unload many kinds of commodities, and in normal times about half the foreign commerce of China passes through the port. Most of its interior trade goes by way of the Yangtze River system, but the city is also linked by the Soochow Creek to the Grand Canal, about 40 miles away. Railways connect it with Peiping (Peking), Nanking, and Hangchow; there are also commercial air lines.

Cheap labor supplies Shanghai's factories. The city's chief industries are filatures (silk-reeling factories), cotton mills, and engineering plants. It manufactures many other staple goods. The city is also a world financial center and has branch banks from many foreign nations.

For many years Shanghai was virtually untouched by the turmoil of modern China. But beginning in the 1930's it became a battleground. After anti-Japanese riots in the native districts in 1932, Japanese troops shelled Chapei. In 1937 the Japanese captured Shanghai after a four months' siege. England withdrew its troops in 1940 and the United States removed its Marines in 1941. Both nations gave up their extraterritorial rights in

1943. When Japan entered World War II, most of the foreign residents fled. Allied planes bombed the city, but spared the Bund and the modern central district. Shanghai came under complete Chinese control in 1945; and in 1949 Chinese Communists captured the city. Population (1947 est.), 4,300,630.

SHANTUNG (*shăn'tŭng'*), CHINA. Time and again foreign nations have sought control of rich Shantung Province in China. This gateway to north China is only about the size of Iowa, but its land supports 38,671,999 people (1947 est.). They farm chiefly on the alluvial plains of the Hwang Ho, or Yellow River (*see* Hwang River). Some valleys in the treeless highlands of eastern Shantung are among the most thickly populated districts in the world. The province is rich in coal and iron. It also produces Shantung, a ribby pongee made from silk spun by caterpillars that feed on oak leaves. Each year Chinese pilgrims come here, for it is the birthplace of Confucius. Near Tsinan, the capital, is the sacred mountain of T'ai-Shan.

Resources, good harbors, and position athwart the main routes to south China have developed several large trade cities. Tsinan, the largest, was the first city in China voluntarily opened to foreign trade. Tsingtao, also modernized by Western influence, is the chief port. Chefoo and Weihsien, large ports, are centers of the hair-net industry. Shantung was dominated by Germany from 1897 until World War I. Japan seized it in 1914 but restored it to China in 1922. Japan seized it again in 1937 but surrendered it once more in 1945. It was captured by Chinese Communists in 1948. The next year the United States Navy abandoned its base in Tsingtao.

SHARKS. The "tigers of the sea" are the sharks. They are hunters of fish and other sea creatures. At least one kind is known to attack man. Another kind feeds on plankton. Sharks are among the oldest and most primitive of fish. They differ from more highly developed fishes in having slits instead of movable gill coverings; a skeleton of cartilage instead of bone; and a tough skin, dotted with *denticles* (little teeth). Each denticle has an enamel covering and a cavity inside, with blood vessels and nerves.

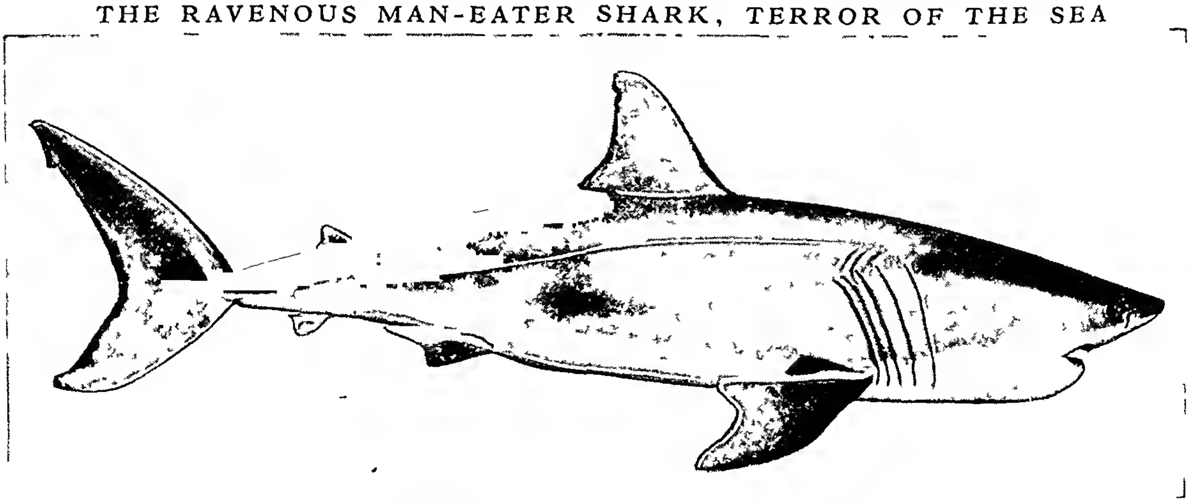
The shark's teeth are similar to denticles. They are set into the gums in rows, and as one row wears out another takes its place (*see* Teeth). Some species have many rows, which make blocklike "pavement teeth" for crushing shellfish. The shark's mouth is on the underside of the head. Below the surface of the water it eats mouth down. To seize prey on the surface it usually rolls over on its back.

Some species bear a few fully formed young once a year. In most species the young hatch from an egg enclosed in a leathery envelope. These usually have long tendrils that curl around rocks and seaweed and keep the eggs from drifting ashore. Empty egg cases, called "sea purses," are often cast up on beaches (For picture of the curious egg case of the Port Jackson shark, *see* Egg.)

There are more than 150 species of shark. All live in salt water, except the fresh-water shark of Lake Nicaragua in Central America. Most sharks are swift, powerful swimmers. They wander hundreds of miles, hunting prey. A few species live on the ocean bottom. The largest of all is the whale shark. It may grow to be 50 feet long and weigh 20 tons. It is harmless to man. Its denticles are only one eighth of an inch long. It feeds on minute organisms called plankton. The basking shark of the polar regions is almost as large and equally harmless.

The man-eater, or great white, shark of the tropical oceans is the most ferocious. The few proved records of sharks attacking man all refer to this species. It is sometimes 40 feet long. The little dogfish shark is common on both the Atlantic and the Pacific coasts of America. On sandy southern shores of the United States is the nurse shark. As it comes close to shore for mating, its fins are thrust out of the shallow water.

THE RAVENOUS MAN-EATER SHARK, TERROR OF THE SEA



The man-eater shark, also called the great white shark (*Carcharodon carcharias*), is a very large and extremely dangerous fish. It eats other sea creatures and is known to attack man. These sharks reach a length of 30 to 40 feet. They have large triangular teeth with saw-tooth edges. They are found in temperate and tropical parts of the Atlantic and Pacific oceans, usually in the open sea. Occasionally they are seen near the coasts as far north as New York and Monterey Bay.

A strange looking species is the fox or thresher shark. The upper lobe of its tail is half the total length of the fish and may be 7 to 10 feet long. It lashes its tail about to herd a school of fish into a close mass, then scoops large numbers into its mouth. Another odd species is the hammerhead shark. The head grows sideways until it looks like a hammer. The eyes are on the outer edges. The bonnethead has a large semicircular head. The angel shark, or monk fish, has a broad flat body. Sand and mackerel sharks are common on the coasts of North America.

Shark liver oil is a good source of Vitamin A. The hide, with denticles removed, makes a strong, durable leather. With the denticles in place it is known as *shagreen*. Carpenters and metalworkers once used it for smoothing and polishing and on handles and boxes. Shark flesh is sold as fresh steaks and as dried salt fillets. Oriental peoples use the fins of a shark called "soupfin" in soup.

Scientists group sharks and rays as *Selachii* or *Elasmobranchii*. Typical sharks belong to families as follows: thresher, *Alopiidae;* hammerhead, *Sphyrnidae;* nurse, *Ginglymostomidae;* dogfish, *Squalidae;* angel or monk fish, *Squatinidae;* sand, *Odontaspidae;* mackerel, *Lamnidae;* gray sharks, *Carchariidae;* whale shark, *Rhineodontidae;* blue shark, *Galeidae.* (*See also* Fish.)

BERNARD SHAW

Shaw's fame rests on both his personality and his skill as a playwright.

SHAW, GEORGE BERNARD (1856–1950). "I have been dinning into the public head that I am an extraordinarily witty, brilliant and clever man. That is now part of the public opinion of England; and no power in heaven or on earth will ever change it." Bernard Shaw wrote this of himself in 1898. He was then 42 years old. A tall, thin, red-bearded man, he was already well known in London as a critic of music, art, and drama. He was an influential socialist speaker and he had written plays that attacked the accepted ideas of his time.

For more than 50 years Shaw continued his humorous self-advertising. The public rarely resented this, because he proved time and again by his work that he was indeed a genius. But his close associates sometimes found him overbearing. Oscar Wilde sarcastically complained, "Shaw has no enemies, but none of his friends like him."

"G.B.S." (as Shaw is often called) was born in Dublin, Ireland, on July 26, 1856. His family were Irish Protestants. His father had a small wholesale business, but drank heavily and neglected his affairs. His mother was a cold, humorless woman whose main interest was music. Eventually she and her husband were separated. Shaw said of his early years, "A devil of a childhood, rich only in dreams, frightful and loveless in realities."

Shaw finished his formal education at a business college. When he was 15, he became a clerk in a real-estate agency. He was an efficient worker, but he saw no future in an office. In 1876 he left Dublin and went to live with his mother in London. For nine years he earned no money. He studied music at home and learned by heart the scores of symphonies and operas. Wagner was his special favorite. Beginning in 1879, he wrote five novels, but sold none of them. He began attending socialist meetings. He joined the newly formed Fabian Society in 1884 and became one of its leading debaters. In 1885 he became art critic for a London paper and later added music and drama to his reviewing work. He also became an enthusiastic vegetarian.

Shaw's first play was 'Widowers' Houses' (1892). He became completely absorbed in the theater and wrote more than 50 plays, nearly all of them successful. His main purpose as a dramatist was to shock people out of conventional, hidebound ways of thinking. Occasionally he presented a character for human interest alone. Among his plays are 'St. Joan', 'Candida', 'Pygmalion', and 'Caesar and Cleopatra'.

In 1898 Shaw married Charlotte Payne-Townshend. They had no children, and Mrs. Shaw died in 1943. In his later years Shaw lived at Ayot St. Lawrence in Hertfordshire. In 1925 he won the Nobel prize for literature. Beginning in 1929, his plays were presented at Shaw festivals at Malvern in Worcestershire.

SHAYS' REBELLION. After the American Revolutionary War the young nation was torn by unsettled economic conditions. Paper money was in circulation, but little of it was honored at face value. Farmers especially were thrown into debt. They wanted more paper money to relieve the crisis; but merchants and other "sound money" men wanted currencies with gold backing. In Massachusetts the "sound money" men controlled the government; and the quarrel grew until thousands of men in the western counties rose up in armed revolt. They were led by Daniel Shays (1747?–1825), a Revolutionary War captain. Shays' Rebellion lasted from August 1786 to February 1787.

The agitators objected to heavy land and poll taxes, high cost of lawsuits, high salaries of state officials, oppressive court decisions, and dictatorial rulings of the state senate. In some towns armed mobs kept the courts from sitting. Shays and his men broke up the state supreme court session at Springfield. The revolt was checked when the militia fired on Shays' party some distance from their goal, the federal arsenal at Springfield. The leaders were condemned to death for treason, but were later pardoned. Shays himself later received a war pension.

Shays' Rebellion was one of several disturbances in different states. It hastened the movement for a Federal government strong enough "to ensure domestic tranquility," as stated in the preamble to the Constitution which established the United States.

The Timid SHEEP *Whose Coats* KEEP MEN WARM

This picture shows how lambs are separated from the mother ewes. The rancher lets the lambs go on through the passageway, but opens the gate in front of each ewe, forcing it into the side pen.

SHEEP. Thousands of years ago, before history began, men tamed wild sheep and kept them in flocks. Men did this because the sheep was immensely valuable to them. They could eat the flesh. They could use the warm, fleecy pelt for garments. Then they learned to shear off the wool and make it into felt or cloth. Thereby they spared the animal to grow another coat.

All this occurred somewhere in mountainous regions in Asia, because the wild sheep lives in mountains. Many of them live higher up in the mountains than any other four-footed animal except goats. Every mountain range in Asia has one or more kinds of wild sheep; but Europe, Africa, and North America have only one kind apiece. South America and Australia have no wild sheep. The sheep on these continents are domesticated kinds which man brought in.

Many Kinds of Wild Sheep

Wild sheep are relatives of goats, and it is not always easy to tell the two apart. But sheep never have beards; goats often do. Sheep have a tear-bag or pit beneath the inner corner of the eyes; goats do not. Sheep's horns twist or curl in flat loops to the side of their heads; goats' horns grow straight up from their heads. The horns bend over their backs, sometimes curling tightly at the tips.

The big horn, or Rocky Mountain sheep, of North America is one of the largest varieties of wild sheep (*see* Big Horn). Some species related to the big horn are found in Asia. Although there are great differences in size and color between the wild sheep of America and Asia, they are all probably related. The *mouflon*, the only kind of sheep native to Europe, is found on the islands of Corsica and Sardinia. The *aoudad*, or Barbary sheep lives in the Atlas Mountains of north Africa. It is a large animal, resembling a goat. It has large horns and long hair on the breast and forelegs. The *argali* of Mongolia and the "Marco Polo sheep" of the Pamir Plateau are the largest members of the sheep family. The argali has unusually long, massive horns. The Marco Polo is named for the famous traveler, who first described it It has wide, spreading horns.

Other varieties of wild sheep in Asia are the *sha* or *urial*, found in southern Asia; the *burrhel* or blue sheep, of the Himalaya Mountains; and the *sair*, which ranges over the Altai Mountains. The burrhel is like the goat in many ways. For example, they both lack eye glands. The burrhel seems to be a connecting link between the goats and the sheep.

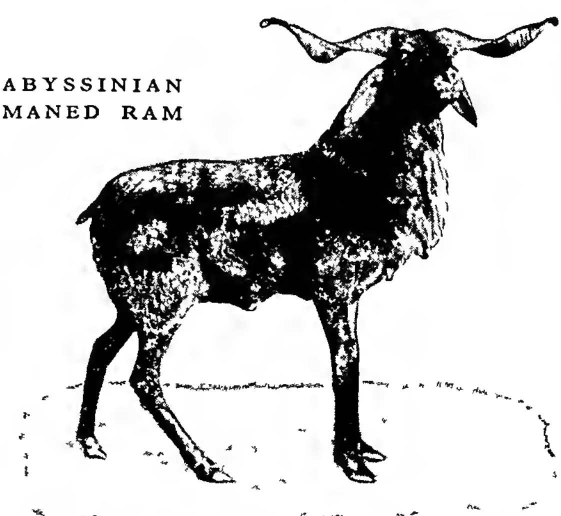
Traits of Wild and Domestic Sheep

Sheep live in flocks. They follow a leader, usually an old ram (male sheep).

Wild sheep are very timid and flee at the approach of danger. But if they cannot escape the danger, they will fight. Ewes (female sheep) often charge dogs that threaten the lambs When a dog attacks ewes with lambs, one ewe leads the lambs away. The others attack the dog. While the dog dodges the attack the lambs escape.

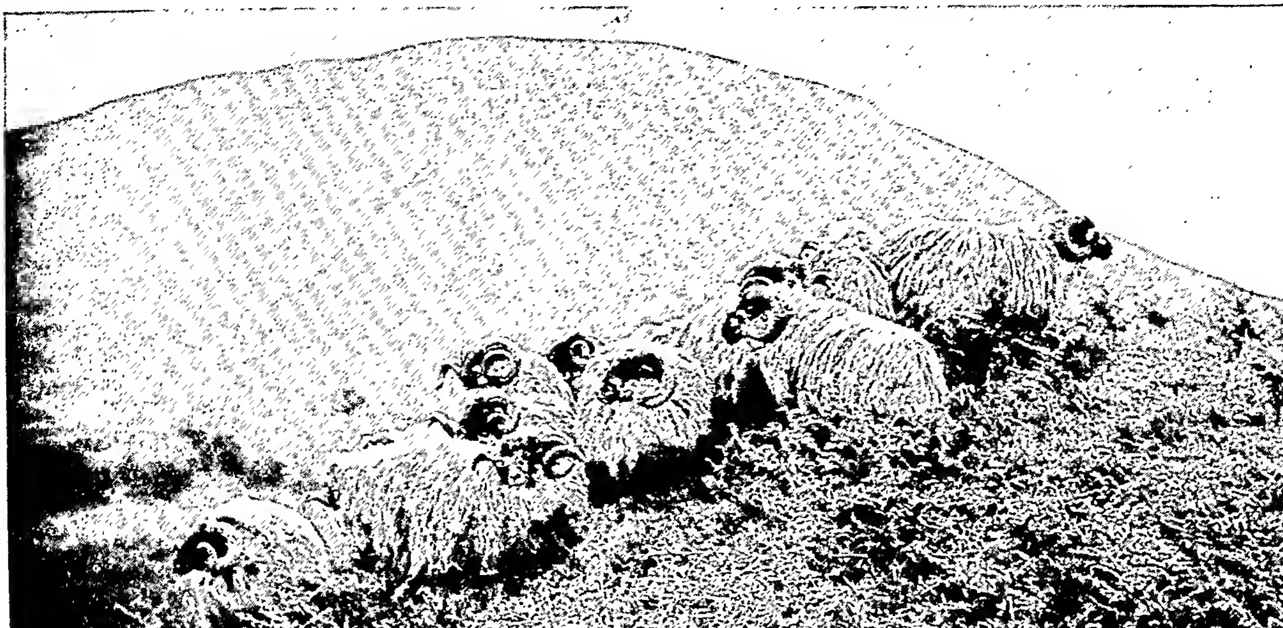
Domestic sheep are entirely dependent on man for food and protection. A flock of domestic sheep are

ABYSSINIAN MANED RAM



We know this animal is a ram by his long, curled horns. His wild breed shows in his dark, hairy coat, long mane, and short tail. Abyssinian sheep roam the mountains of east Africa.

SHEEP BREEDS NOTED FOR WOOL OR FOR MUTTON



Stockmen have crossbred sheep to create varieties suited to yield abundant fine wool or meat or for both purposes. The Scotch Blackface breed, at the top, are excellent for mutton, but their wool is long and coarse. The Southdown, at lower left, is a good meat animal, and its fleece is fine and short. The Merino ram, at lower right, belongs to a breed considered the greatest wool producers in the world, but it is not built for meat production. Sheep find nourishment in plants that cattle will not eat, and they are more sure-footed in steep, rocky places. Regions noted for sheep raising are generally rugged or dry.

pitifully timid and cowardly. A sheet of paper blown by the wind will frighten the flock. A clap of thunder may throw them into a panic. They may drown without a struggle if they are scared while fording a stream. Fire in a sheepfold destroys most of the sheep, because they are too frightened to leave the building. Even after they have been driven out, they may run back into the flaming building in their blind terror.

Domestic ewes bear one or two lambs in the spring. On the first or second day after birth, the lambs are strong enough to follow their mother. They usually become heavy enough to be sold for slaughter when they are three months old. The meat is called lamb until the animal is a year old. The flesh of older sheep is known as mutton.

In some lands, the people drink ewe's milk or make butter or cheese from it. The French use it in the Roquefort cheese they sell all over the world.

The origin of domestic sheep is unknown, but it is almost certain that several, perhaps many, varieties of wild sheep were tamed and that the modern varieties of domestic sheep are the result of crossbreeding. The domestic varieties bear little resemblance to any wild species that exist today. Most domestic breeds are hornless, though some domestic breeds have horns. Nearly all bear wool instead of the long, coarse hair of wild sheep.

The commonest and best known of the domestic breeds is the Merino, which originated in Spain in the 15th century. It is famous for the large quantity

and fine quality of wool it produces. The Merino has been used to improve most, if not all, of the other European short-wool breeds.

In the beginning of the 19th century Merino rams were imported into America, often at fabulous prices, and the flocks gradually spread westward over the fertile lands of the Great Lakes region, and southward to the Ohio. When the land in this region became too valuable to make the sheep industry profitable at the prevailing prices of wool, large flocks were established throughout the west, from Montana to Texas, and over the Rocky Mountains to the Pacific coast. More than two-thirds of the sheep of the United States are found west of the Mississippi. Since 1910 the number of sheep in the country has considerably decreased, despite the great advance in the price of wool and mutton.

The Best Wool in All the World

The American Merinos produce the best wool in the world, and for many years this breed predominated, but gradually the demand for a better mutton-producing sheep than the Merino resulted in the introduction of various English breeds. Among these the Cotswold was long a favorite, but many other varieties were imported from time to time, and flocks of Southdowns, Shropshires, Hampshires, and Oxford Downs are now found in many parts of the country. They produce wool of medium and long fiber. The "improved Leicester," developed in England, is the progenitor of most long-wool breeds, such as Lincolns and Cotswolds.

The Delaine Merino, from which the fine Delaine wool is derived, is an American product; the breed was developed in western Pennsylvania and eastern Ohio. "Saxony," another popular wool of excellent quality, is derived from Merino sheep which were introduced into Saxony from Spain. The Rambouillet breed, which originated in France and is a descendant of the Spanish Merino, is larger than the Merino and has recently become popular with American sheep-breeders. The Cheviot is a Scottish mountain sheep producing a medium-length fine wool.

The fat-tailed sheep, found in many parts of Africa and Asia, is remarkable for the quantity of fat which accumulates in its tail; in some instances the tail weighs from 50 to 80 pounds. The shepherds fasten a board to the underside of the tail, and sometimes attach wheels to the board to enable the sheep to carry its tail without injury. The fat is highly esteemed as a delicacy and is often used instead of butter. The new-born lambs of other Asiatic sheep, such as those of the Karakul breed, have a very fine wool twisted in spiral curls which is in high demand as fur for coats and trimming.

The chief sheep-raising countries of the world are Australia, Argentina, Russia, the United States, South Africa, India, the British Isles, Uruguay, New Zealand, and Spain. (*See also* Wool.)

Sheep belong to the genus *Ovis*, of the family *Bovidae*. They are ruminant animals (*see* Ruminants).

SHEFFIELD, ENGLAND. All over the world "Sheffield" means fine cutlery, such as knives, razors, scissors, surgical instruments, together with mathematical instruments, files, saws, and engineering tools of all kinds. Heavy steel, too, is manufactured there—armor plate, rails, engines, machinery, guns and shells—and cast-iron articles, such as stoves and grates, as well as silver and brass ware. Next to the mayor, the highest dignitary in town is the Master Cutler of the ancient Cutler's Company, which exercises jurisdiction over trademarks on metal goods and over all persons in business in the district of the West Riding of Yorkshire, in which Sheffield is situated. The famous "Sheffield plate" (silver) is no longer manufactured, the process having been abandoned in favor of cheaper methods.

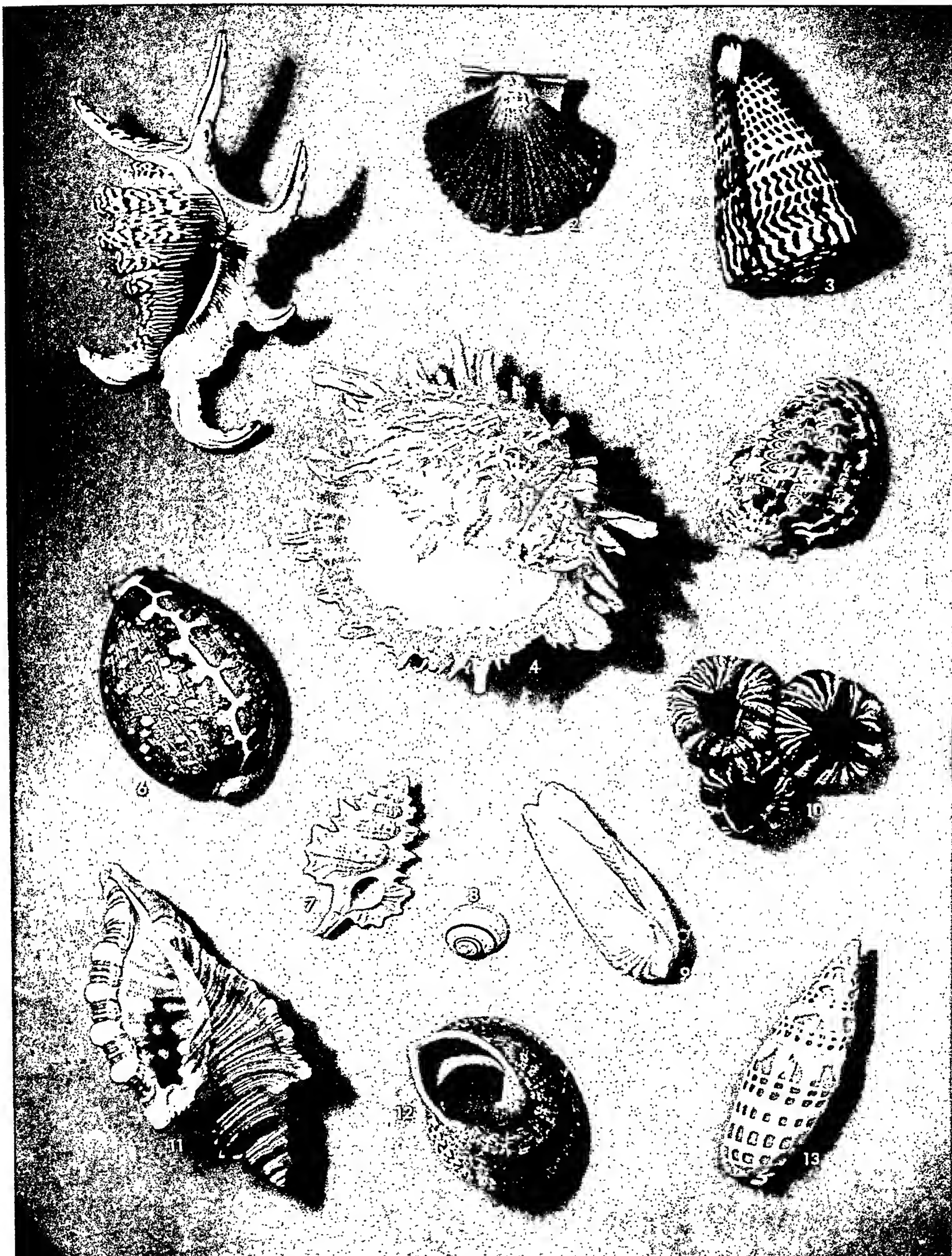
Sheffield's preëminence in the steel industry is due in part to its situation in the Yorkshire-Derbyshire coal field; yet iron was smelted with charcoal in the district probably in Roman times—certainly by the time of the Norman Conquest—and Sheffield blades were famous long before "pit coal" was used in the manufacture of iron and steel. The Miller in Chaucer's 'Canterbury Tales' carried a "Sheffield thwytel" or knife. It was a Sheffield man, Benjamin Huntsman, who in 1740 introduced the process of making crucible steel from bar or blister steel, which is still used in making Sheffield fine cutlery. Henry Bessemer established his first steel works in Sheffield, and much Bessemer steel is still manufactured there.

Like some of the Pennsylvania steel towns, Sheffield is smoky and dirty, but it is delightfully situated at the base of hills on the river Don, a tributary of the Humber. Its most interesting public building is St. Peter's Church, originally built in Norman times and burnt during the wars of Edward III with the barons, but rebuilt; the oldest standing part, the tower, dates from the 14th century. Sheffield University, founded in 1905, comprises, besides the departments of medicine, arts, science, commerce, etc., a technical school with laboratories and shops. Population (1951 census, preliminary), 512,834.

SHELL. The varied shells found on the shores of the sea, in the forests, and along the banks of lakes and rivers are simply stone forts which soft-bodied mollusks or other animals build around themselves for protection. They are composed of substances secreted by the glands of the mollusks and consist largely of carbonate of lime, which is the basic ingredient of limestone, chalk, and marble. Lime is often obtained commercially by burning piles of shells.

The Shell Creature's Coat

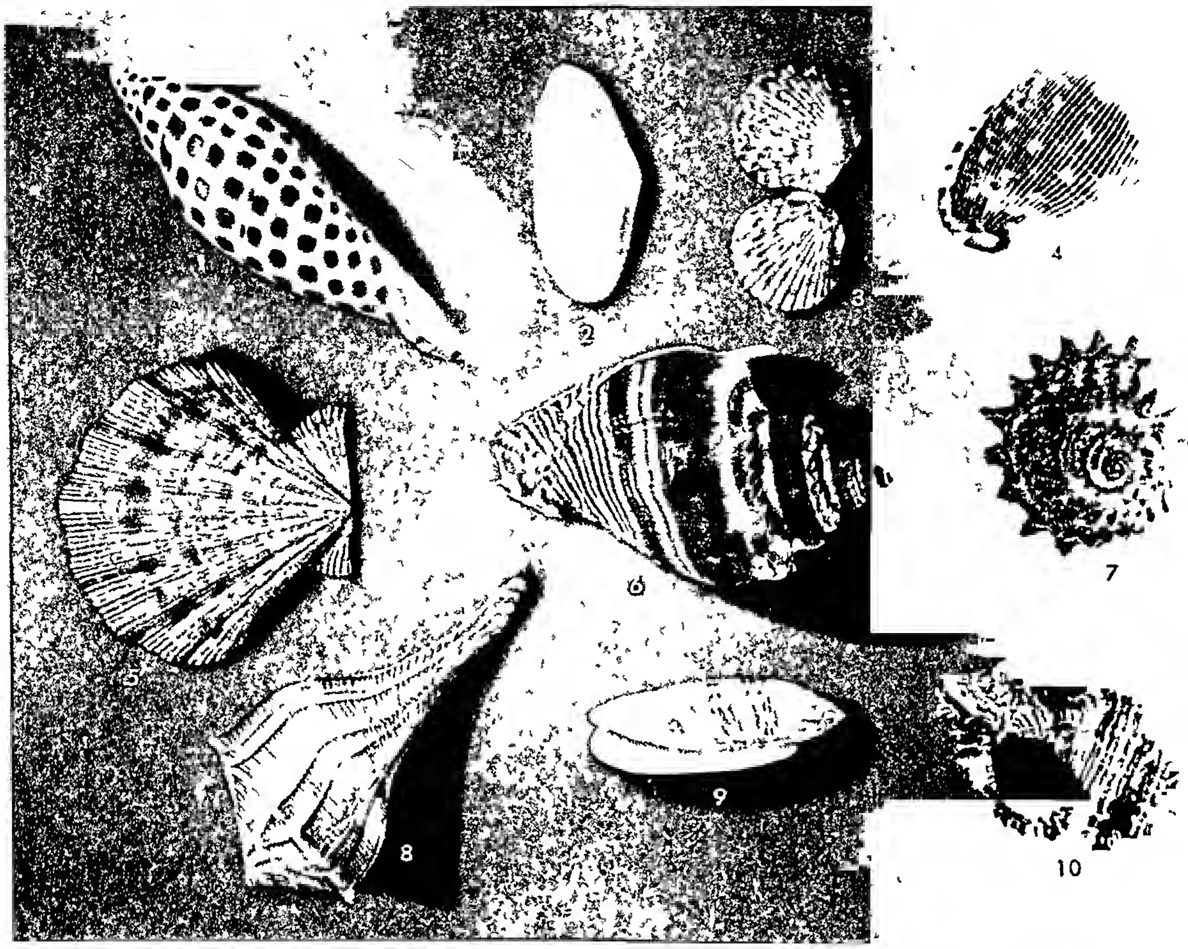
As a mollusk grows in size, its shell increases in thickness and extent. The lines of growth are usually clearly marked by the ridges running parallel to the outer or free edge. These are clearly visible in oyster and clam shells. The other ridges and protuberances on a shell are caused by corresponding projections on the "mantle," or muscular tissue, which form the mollusk's back (*see* Mollusks).



Direct-color photograph *By Ruth Bernhard*

COLORFUL SHELLS FROM DISTANT SEAS

1. Scorpion shell (East Africa). 2. Jacob's fan, or St. James's scallop (Mediterranean). 3. Lettered cone (Celebes). 4. Hinged oyster (Gulf of California). 5. Harp shell (East Africa). 6. Map cowrie (Japan). 7. Frog shell (Japan). 8. Painted snail (Cuba). 9. Angel wings (Florida). 10. Whale barnacle (northern seas). 11. Triangular trumpet (Bahamas). 12. Garibaldi's snail (Philippines). 13. Bishop's miter, or episcopal miter (tropical seas).



SHELLS OF THE ATLANTIC AND GULF COASTS

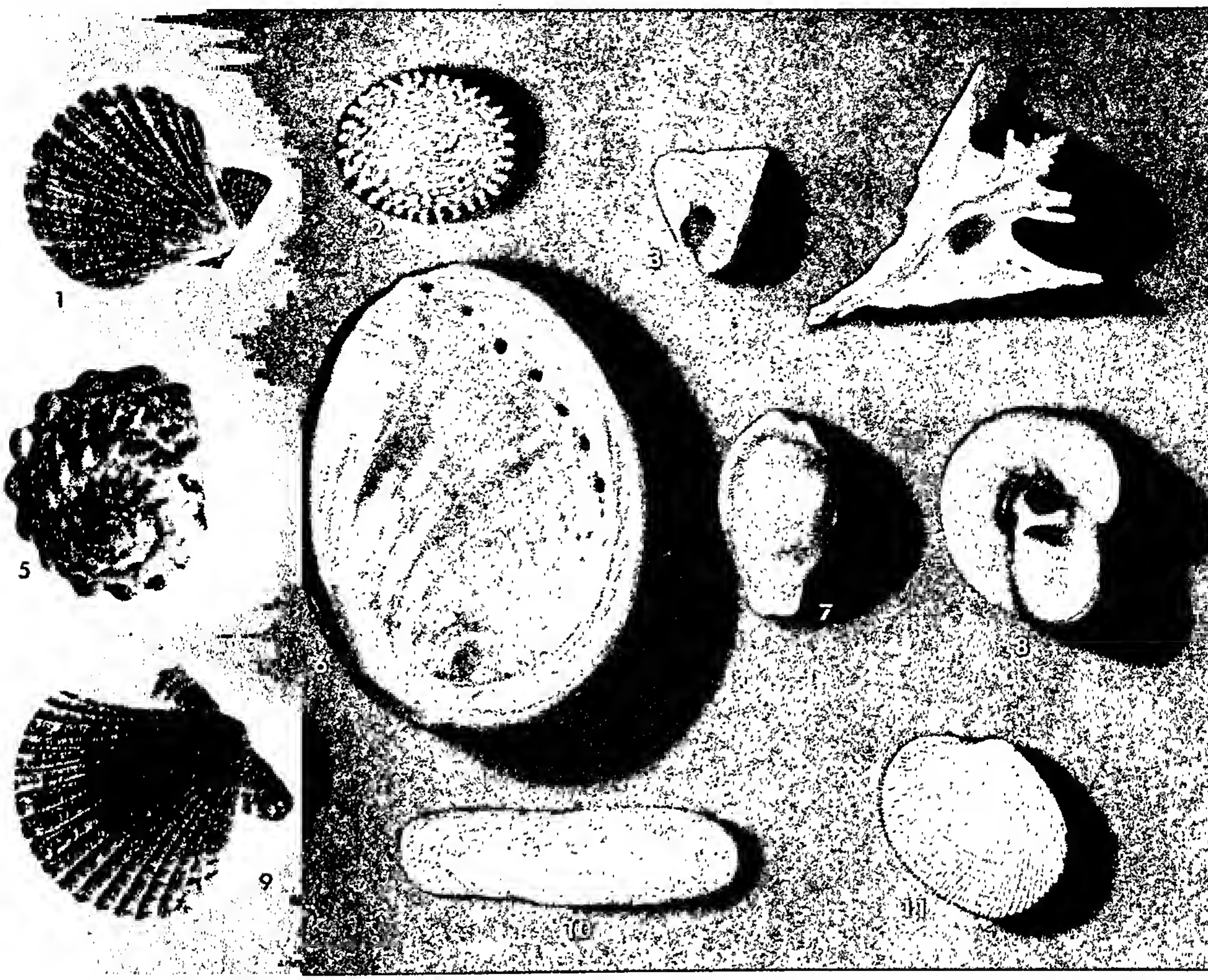
1 Junonia (South Carolina to Gulf Coast) 2 Rising sun (South Carolina to West Indies) 3. Calico scallop (North Carolina to Cuba). 4 Baby bonnet (Cape Hatteras to Cuba) 5 Lion's paw (Cape Hatteras to Florida Gulf Coast) 6 Crowned conch (Atlantic and Gulf coasts of Florida) 7 Star shell (southern Florida coast) 8 Lightning conch, or left-handed whelk (Florida to Texas) 9. Olive shell (North Carolina to Texas) 10 Apple murex (North Carolina to Venezuela)

The mollusk shell consists of three layers. The outer surface is covered with a thin layer of hornlike material which contains no lime. Beneath this is a layer of very small prisms of carbonate of lime. Lastly, forming the internal layer in certain groups of mollusks, but not all, is the nacre, or mother-of-pearl. This is composed of extremely thin alternate layers of carbonate of lime and a horny substance. These layers are translucent and refract the light to produce a beautiful iridescent appearance. The outside of the shell may be white, black, brown, tan, purple, red, or rose, but usually has a pattern combining several colors, tints, or shades. The color of the interior is usually paler and more delicate than that of the exterior. Shells of the tropics are usually more highly colored than those found in temperate zones.

When you look at a collection of shells you are amazed at the infinite variety of shapes represented. Many of them so closely resemble other natural objects, or objects of human invention, that they are known as "miter," "harp," "helmet," "top," "razor," "turban," "cone," "basket," "lamp," "frog," "trumpet," "ear," and "slipper" shells. Most are marked with ridges, folds, frills, or spines, corresponding to the growth or structural peculiarities of the animal that lived in them.

Despite the great variety of these forms, they nearly all fall into one of two great groups—those having a shell in one piece, such as the snails, and those having a shell in two pieces hinged at the back, such as the oysters and clams. The one-piece shells are called *univalves* and the two-piece shells *bivalves*. All the land shells are univalves, but the shells found in the water may be either univalves or bivalves. Besides these two great classes, there is another kind which is much less common in which the shell consists of eight overlapping plates connected by a leathery girdle. The chitons that wear these "coat of mail" shells are found only in salt water.

Among the common bivalves found on or near the seashore are the oyster, clam, mussel, scallop, cockle, razor shell, and the teredo, or shipworm. All



SHELLS OF THE PACIFIC COAST

1. Pink scallop (Alaska to San Diego). 2. Plate limpet (Aleutians to Gulf of Calif.). 3. Channeled top (Alaska to San Diego). 4. Three-cornered trophon (Catalina I. and San Pedro). 5. Wavy top (San Pedro to Lower Calif.). 6. Black abalone (Oregon to Lower Calif.). 7. Chestnut cowrie (Santa Barbara to San Diego). 8. Smooth turban (central to Lower Calif.). 9. Speckled scallop (Santa Barbara to Lower Calif.). 10. Broad razór (Monterey to Panama). 11. Rock Venus (San Francisco to Aleutians).

these are mollusks, but other interesting bivalves which are not mollusks also live near the shore, usually in deep water. These are the lamp shells, or brachiopods, which are really shelled worms.

The largest of the shells is the giant clam of the Indian and Pacific oceans, which grows to be from two to three feet in diameter and sometimes weighs four hundred pounds. Single valves of these shells are sometimes used as receptacles for holy water. Divers for pearls and sponges are said to have been trapped by this great shell.

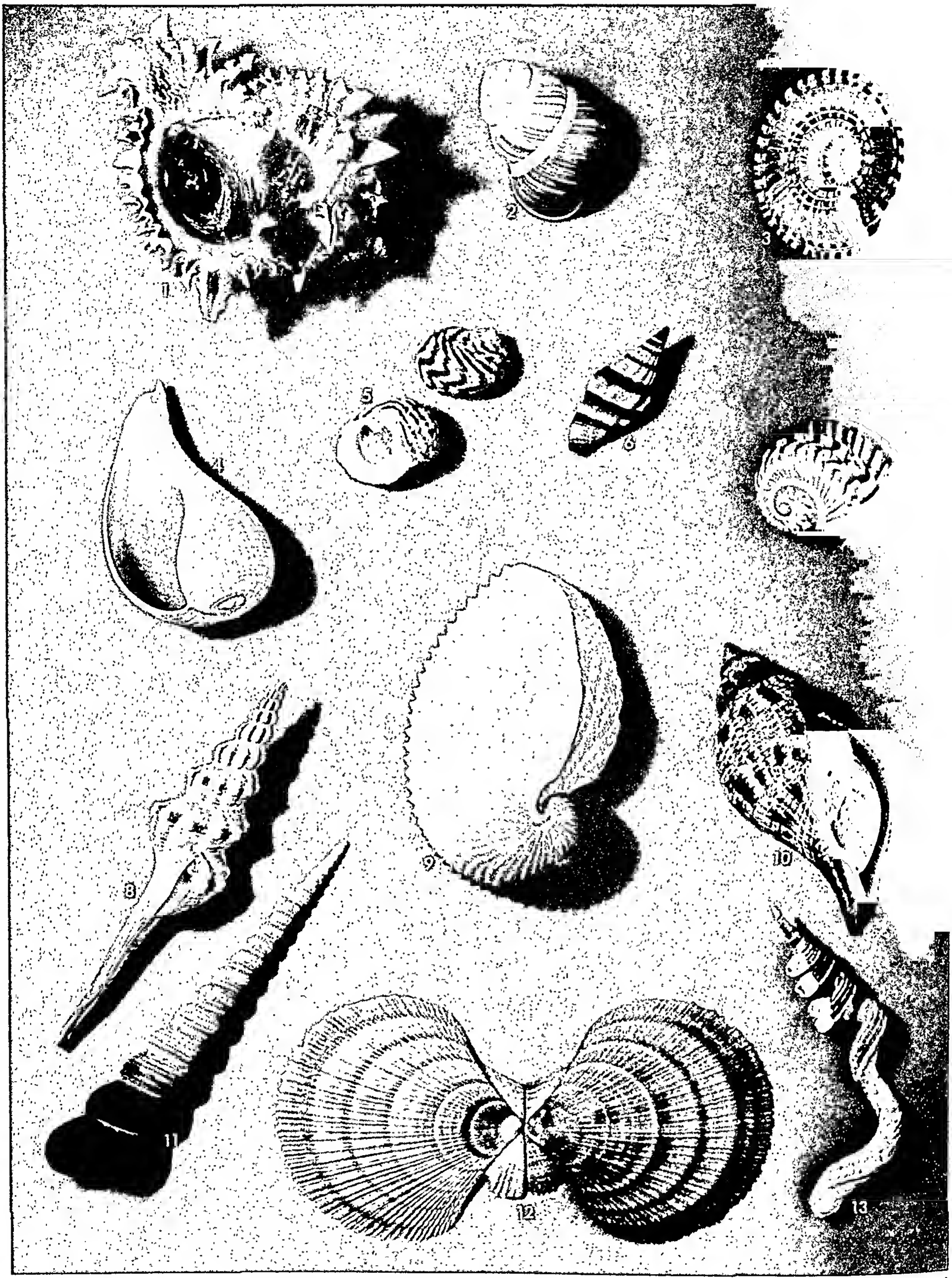
Most of the univalve shells are conical with the spiral, when viewed from above, turning counterclockwise. Those that twist in the opposite direction are called left-handed shells. The so-called tooth shells are cylinders open at both ends and resemble an animal's tooth. They are not true univalves.

The beautifully conical conch shell is found on the Florida coast and in the West Indies. The horse conch is the largest shell native to any part of the United States. It grows to be $1\frac{3}{4}$ feet long.

Because of their beautiful coloring, many shells are manufactured into articles of adornment, such as brooches, bracelets, necklaces, and buttons (*see* Buttons). They are also used for inlaying furniture, musical instruments, and other articles. Several kinds of abalones, or ear shells, are found on the shores of California. Here they sometimes grow ten inches long. Both the inside and outside take a high polish. These shells furnish mother-of-pearl for buttons, jewelry, and other items of commerce.

The beautiful turban shells from the Indian Ocean, the Philippines, and the Sea of Japan are also in great demand. They are large heavy shells, with rounded whorls shaped like a turban. The giant of the family is the green turban, or green snail.

The helmet shells are notable for their use as cameos. They have a dark coat under a pale outer layer, so that figures carved on them stand out in bold relief. The best for this purpose is the black helmet, which is found on the Atlantic coast from North Carolina to the West Indies (*see* Cameo).

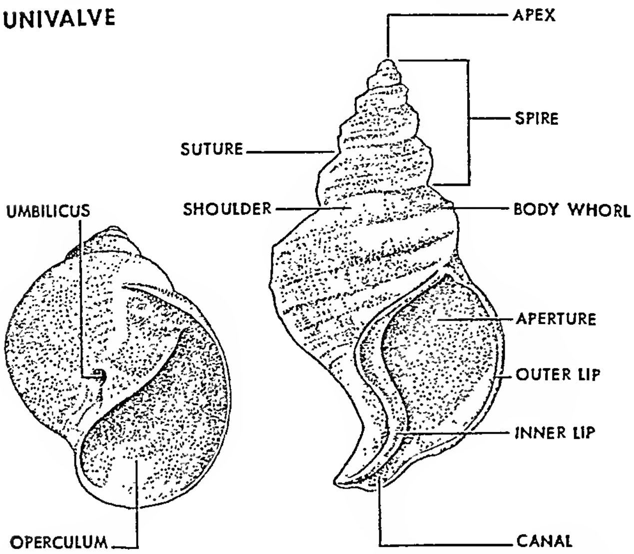


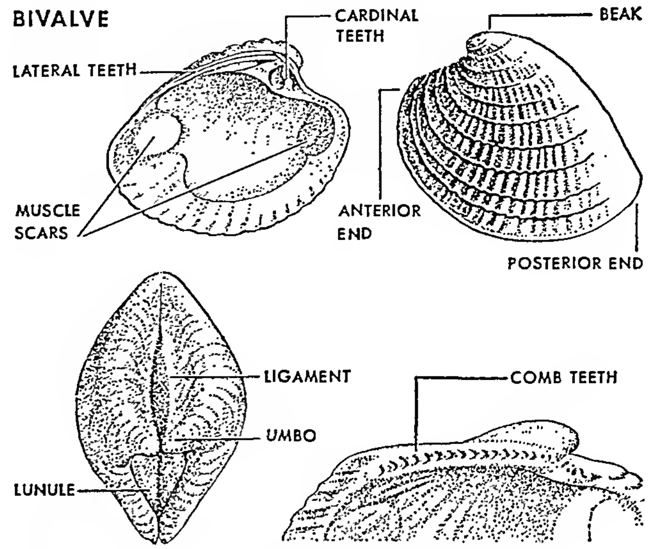
Direct-color photograph *By Ruth Bernhard*

SCULPTURED CASTLES OF THE DEEP

1. Royal rock shell (Panama). 2. Green tree snail (Philippines). 3. Staircase shell (Japan). 4. Paper fig shell (Florida). 5. Bleeding tooth shell (Bahamas). 6. Little fox miter (Fiji Islands). 7. Moon shell (Florida). 8. Spindle shell (Japan). 9. Paper nautilus (China seas). 10. Tulip shell (North Carolina to West Indies). 11. Gimlet tower or great screw shell (Philippines). 12. Northern scallop (Iceland). 13. Worm shell (Atlantic Ocean).

SCIENTIFIC NAMES USED IN DESCRIBING SHELLS





Shell collectors like to know the technical names used in guidebooks to describe and identify shells. Some of these shown here need explanation. The *suture* in a univalve is the spiral line of the spire where one whorl touches another. The *umbilicus* is a small hollow at the base of the body whorl. The *operculum* is the plate, or door, which closes the aperture (opening) of some snails. The *umbo* is the swelling part of a bivalve near the beak. The *lunule* is a heart-shaped depressed area in front of the umbo in many clams. The *ligament* is the cartilage which connects the valves of bivalves.

Among many primitive peoples shells were used for money. The most widely used shells for this purpose were certain kinds of cowries, or Venus's-shells. The ringed cowrie is still the usual currency in a few remote Indian and Pacific islands. Some tribes in the interior of Africa use strings of the "money cowrie." Along the west coast of Africa this was the usual currency until past the middle of the 19th century. Traders made large fortunes by gathering these shells in the Indian or Pacific oceans and exchanging them for ivory and other valuable goods in Africa.

The currency of the American Indians, known as wampum, consisted of cylindrical pieces of quahog, whelk, and periwinkle shells, rubbed smooth and strung like beads on strands of skin. The white beads were generally rated at only half the value of the purple beads made from the quahog, or hard clam.

Shell Collecting as a Hobby

Collecting shells is a hobby that often leads to a serious interest in science. The collections are permanent, for shells do not lose their color, they do not decay, and they are not attacked by insects.

Every walk along the beach adds new specimens. They may be found in rock crevices and on open beaches, in tide pools, and in the line of debris left by the tides, called sea wrack. Near the low-water level are shells that must be dug out with a shovel.

Fresh-water shells may be found in streams and ponds, in swamps and ditches. Snails are common in hardwood forests, but not in pine forests. Specimens may be found on the forest floor, in rotten logs, in old brush piles, and on moss-covered limestone.

Large shell collections are built up by exchanging duplicates with other collectors. Hence it is wise to take a number of specimens. A notebook should be carried in which records may be made at the time of collecting, lest important data be forgotten.

The animal is killed by dipping the shell in boiling water for a minute or two and removing the body with tweezers. Very small mollusks cannot be removed in this way without injuring the shell. They should be placed in 50 per cent or 70 per cent alcohol for 24 hours. All shells should be dried in the shade. If the shell has an operculum, or trap door, it should be saved. The shell opening may be packed with cotton and the operculum glued to the cotton. Larger mussel shells should be placed in boiling water until the two halves open. After the body has been scraped out and before the hinge hardens, the two halves should be tied together with a string. After they have dried the string may be removed and the shell will remain closed. To prevent the thin covering (epidermis) from peeling off, the shell should be lightly greased.

If a collection is to have any real value it must be properly labeled. Each label must show exactly where the shell was found. Notes on tide conditions and weather might also be included.

A society of shell collectors, called the American Malacological Union, has its headquarters at the Academy of Natural Sciences, Philadelphia, Pa. (For the titles of books which will help in identification, *see* the article Hobbies, subhead "The Seashore.")

SHELLEY, PERCY BYSSHE (1792–1822). One of the leading poets of the Romantic movement in English literature was Percy Bysshe Shelley. Though he died before he was 30, he created great masterpieces. Among them are such matchless lyrics as 'The Cloud', 'To a Skylark', and 'Ode to the West Wind'.

Shelley did not seek fame as a poet. He thought of himself as a reformer. He wanted to free mankind, "to purify life of its misery and evil." Shelley knew little of real life, and his schemes for reform were impractical. The critic Matthew Arnold accurately

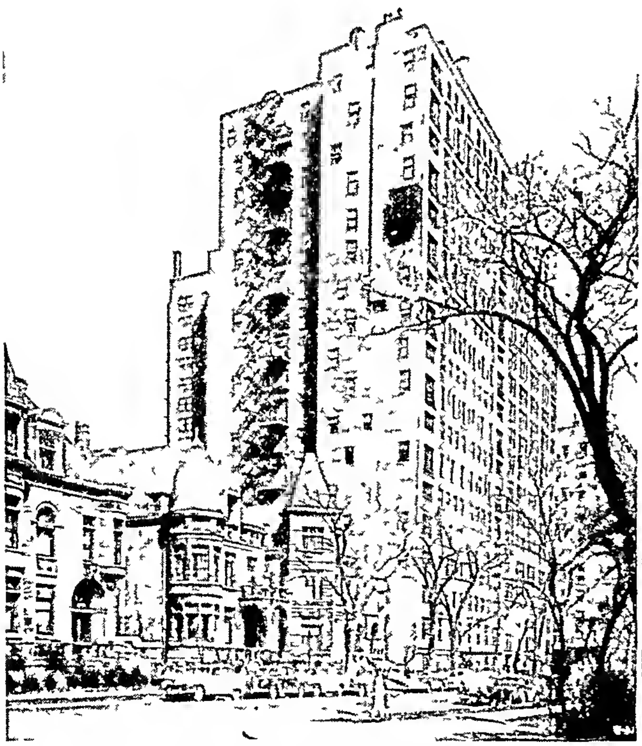
characterized Shelley the reformer as "a beautiful and ineffectual angel, beating in the void his luminous wings in vain."

Shelley was born at Field Place, Warnham, in England on Aug. 4, 1792. His father was a lawyer and a member of parliament. When the boy was 10 he was sent to the Sion House Academy, and two years later he entered Eton preparatory school. At Eton Shelley received the usual hazing given new pupils, but he did not submit easily. He was a good student in Greek and Latin, and in his own room he conducted many scientific experiments. Shelley was different from his classmates. He was a delicate, slender youth with fair skin and large blue eyes. He took no interest in cricket and football, and his schoolmates called him "mad Shelley."

Shelley entered Oxford University in 1810. He was expelled six months later for writing a pamphlet attacking religion. In 1811 he married Harriet Westbrook, a girl of 16. They left for Dublin, where Shelley distributed pamphlets and attempted to arouse the Irish to revolt. Their parents supported the young couple until Shelley received an inheritance from his grandfather. They had two children. But in 1815 they separated, and on Dec. 10, 1816, Harriet Shelley committed suicide. Shelley had already married Mary Godwin, daughter of William Godwin, a well-known essayist and political reformer. Three children were born of this second marriage.

In 1818 the Shelleys left England for Italy. There Shelley wrote his long dramatic poem 'Hellas' and his elegy on the death of John Keats, 'Adonais'. On July 8, 1822, Shelley was drowned while sailing with a friend off Leghorn. His body was recovered and cremated on the beach.

In addition to those mentioned, Shelley's chief long poems are: 'Queen Mab' (1813); 'Alastor, or The Spirit of Solitude' (1816); 'The Revolt of Islam' (1817); 'The Cenci', a tragedy (1819); and 'Epipsychidion' (1821). Among the shorter poems are 'Hymn to Intellectual Beauty' (1816); 'Mont Blanc' (1816); 'Ozymandias' (1817); 'Lines Written among the Euganean Hills' (1818); 'The Indian Serenade' (1819); 'Arethusa' (1820); 'To Night' (1821).



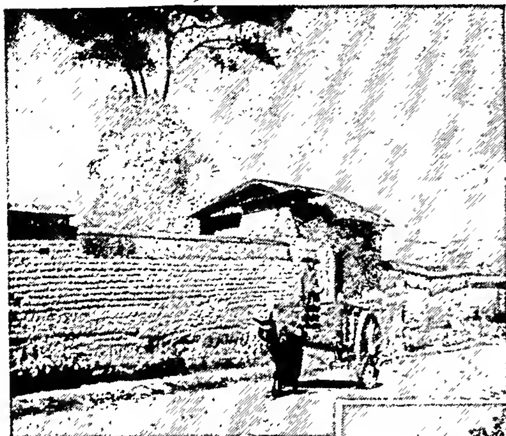
The WORLD-WIDE PROBLEM *of* *Providing* SHELTER

At the left, a tall apartment building rises over smaller houses in a large city. All these homes are strong enough to last longer than a lifetime. At the right, two boys are putting up a tent in the woods They will use the tent for only a day or two. But it will protect them against wind and rain It is a shelter, just like the city apartment building and smaller homes.

SHELTER. Everywhere in the world men and animals are busy providing shelter for themselves. Men use many kinds of materials to make shelters of many different shapes and sizes. Some build houses of wood. Others build mansions of stone or brick, or huge apartment buildings of steel and concrete. Many people live in tents, houseboats, or trailers. Some homes are built over water, and others are perched high in trees.

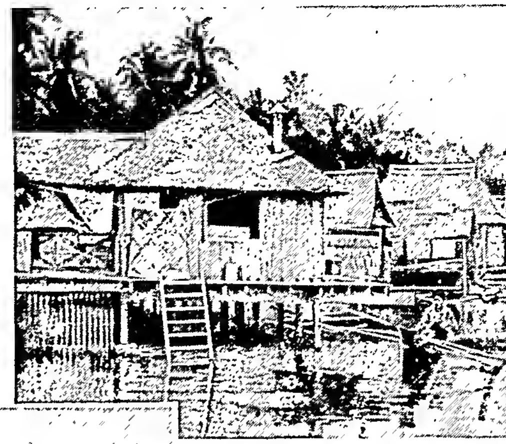
Animals build different kinds of shelters, just as men do. Some shelters may serve animals for a lifetime. Among them are beaver lodges, fox holes, rabbit warrens, and molehills. Other shelters are temporary. Birds make nests for hatching eggs

DIFFERENT KINDS OF HOMES IN MANY LANDS



Mexican house

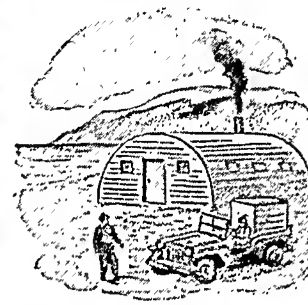
Native tree house



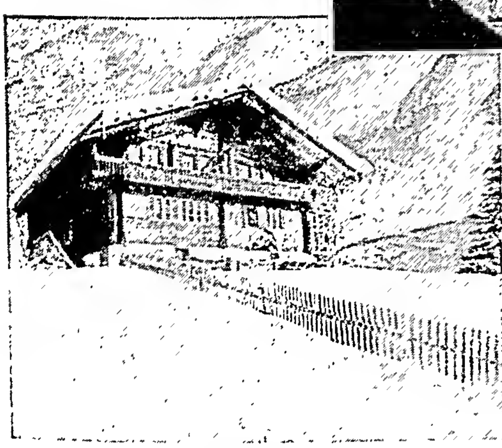
Philippine hut

Chinese houseboat

U.S. housing project

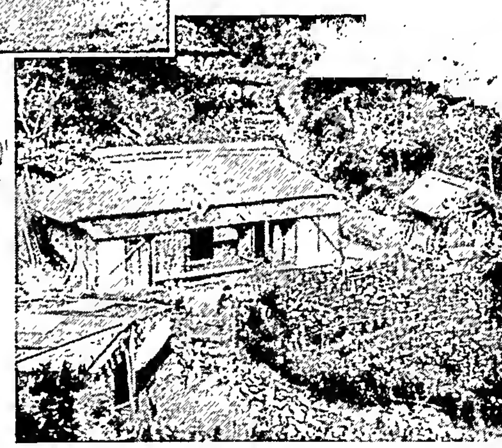


Quonset hut



Swiss chalet

House trailer



Japanese home

Wherever people live they need some kind of shelter for a home. If a person travels around the world he will see shelters of all shapes and sizes. Some homes in foreign lands look very much like those found in the United States. Others are built to suit a particular way of living or to protect people from a very hot or a very cold climate.

and to protect their young. Bears and other animals find caves where they sleep (hibernate) through the winter. But all men and most warm-blooded animals need shelter at some time in their lives.

Why Is Shelter So Important?

Except in the mildest climates, men need shelter as much as they need food and clothing. In cold countries shelter keeps out snow and freezing wind. In hot, dry regions, shelter protects men from a burning sun and scorching wind. In hot, wet lands men need shelter from heavy rains as well as from the sun. In countries like the United States, shelter gives protection against both cold winters and hot summers.

Shelter also protects personal property. It shields clothes, dishes, books, radios, pictures, and other objects from the weather. Shelter also helps to keep out thieves. Some farming peoples use their shelters to store food supplies for the winter.

Shelter is important for a third reason. At one time or another all human beings like to be alone or with their families. Parents and children can find this privacy in their homes.

The Earliest Shelters Used by Men

Scientists say that in the earliest times men did not have much more shelter than animals. Some people built crude huts in trees to be safe from dangerous

HOW SHELTER HAS DEVELOPED THROUGH THE AGES


1


2

1. The first men needed shelter against the weather and wild animals Some of these people found caves to live in. The same cave could be used for thousands of years 2. Much later men learned to build shelters Some of them made a rough framework of sticks or reeds. The family then covered the sides with mud and tied together rushes or leaves to make a *thatched* roof. 3 Today many homes are built by special construction crews. Each man has his own job, and machines do much of the work.

beasts. Others used caves for shelter. They kept fires blazing at the entrance and piled up stone barricades to keep animals away (*see* Man).

Most early people got food by hunting or fishing. The hunters had to follow their game, and often they could not find caves. Then they built windbreaks of tree branches, bark, or animal skins. Some people today still use the same kinds of shelters as the earliest people did. Many families in north China live in caves carved out of the sides of cliffs. Near the southern tip of South America the Ona Indians build nothing but crude windbreaks made of animal skins to protect them from a chilly climate.

Shelters for Early Farmers and Nomads

Men built improved shelters when they learned to make axes of polished stone and later of metal. This made it possible to cut and shape lumber. A second improvement came when people learned to grow crops. They could then settle in one place and build more permanent shelters.

A common kind of house was built of sticks, reeds, and mud. Men built a framework with sticks and reeds (called wattle). They daubed the sides with mud and let it dry hard. Such a shelter is called *wattle and daub*. It is shown in picture 2 on this page. Sometimes men dug a hole for the lower part of the shelter. This construction is called a *pit* house.

Early hunters who followed game were *nomads*—that is, wanderers. People who learned to tend herds of cattle, sheep, or goats often were nomads too. These people had to move from place to place to find grass or a fresh supply of water for their animals. Usually they carried their shelters with them. Some nomads used tents made from animal hair. The Arabs wove tent cloth from goat hair. Mongolians matted wool into felt and used the felt to make shelters called *yurts*. (For pictures of these shelters *see* Arabia and the Arabs; Mongolia.)

Shelter to Guard against Danger

Some early people tried to make their shelters help guard them against enemies. The Swiss lake dwellers built homes over water and made drawbridges to connect with the shore. They could raise the bridges to keep out enemies Some early Indians in the American Southwest built homes on level niches in the sides of cliffs. They reached the homes only by narrow ladders or steps cut into the cliff. These could be defended easily against enemies.

Even today people in many regions build shelters to hold off enemies. Natives on some tropical islands still live in tree houses. Some African people build a circular fence around their villages (called *kraals*). The fence protects both the people and their livestock against lions and other dangerous animals. Other examples are shown in pictures on the next page.

How Early Civilizations Were Sheltered

The first civilized people built their homes in the valley of the Nile in Egypt, the river valleys

of Mesopotamia (now in Iraq), and the valley of the Indus in India. The homes were blocklike and flat-roofed. To make them, the people sun-dried clay to make bricks.

Later, as the nations grew wealthier, well-to-do people built their houses around an open court. They often used stone instead of brick for building. In ancient Greece and Rome, rich home owners had running water, sanitary equipment, and piped heat. In crowded Rome, the people built apartment houses several stories high.

In northern Europe, people faced a colder climate. Here the principal part of a home was a long hall-like room. The roof was high, and it had a steep slope to shed heavy snowfalls. The room was heated by a large fire, but the high roof made the smoke from the fire endurable. An open "wind's eye" (window) under the roof let in light and air and also served as a chimney. During heavy storms chickens and livestock were driven into the house.

Shelter in the Middle Ages

During the Middle Ages, kings and the wealthier lords built fortified castles with thick walls. The lord and his family lived in a large central hall. The castle was dark, and the only heat came from a masonry fire pit at one end of the hall. Near the castle were the huts of the peasants. These workers made their homes from rough timber and chinked the cracks with mud and straw.

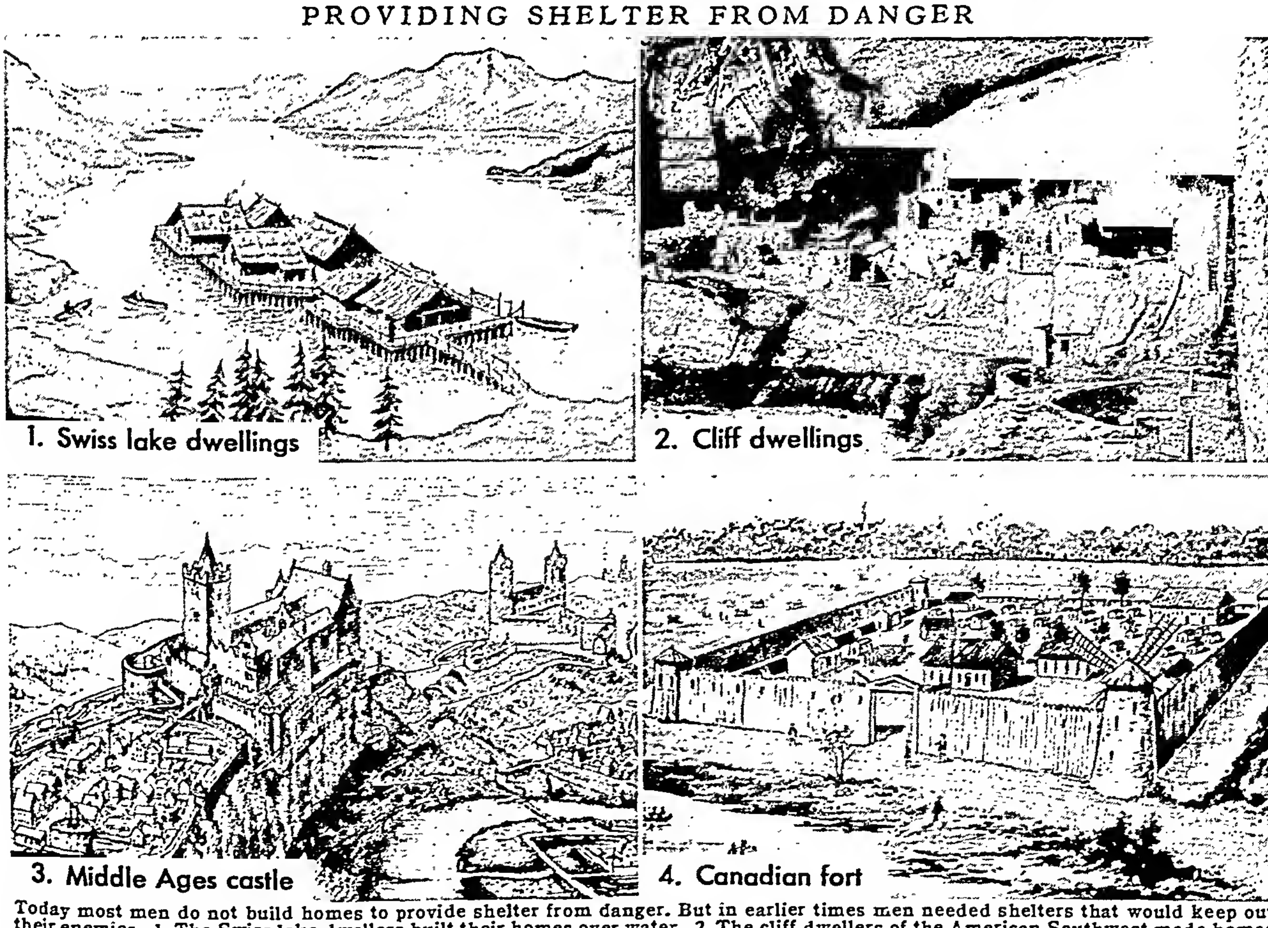
Chimneys were invented in the 1100's, which made it possible to build several rooms, each heated by a fireplace. Windows were just openings that could be closed by a shutter during stormy weather. Glass still cost too much for general use.

In Europe during the Middle Ages, city dwellers feared to build houses beyond the wall that surrounded the town. To provide extra room, builders added more stories to the houses. Some upper stories extended out over the dirty, unpaved streets. These overhanging stories darkened the streets and blocked air circulation. This plan of building is still found in some European countries.

The Middle Ages brought improvements in building materials. Many houses were still built of wood, but stone and *half-timbered* homes became more common. Great wooden beams formed the frame of a half-timbered house. The spaces between the uprights were covered with laths plastered with clay. The old thatched roofs were highly inflammable. Now safer shingles, slate, and tile came into use.

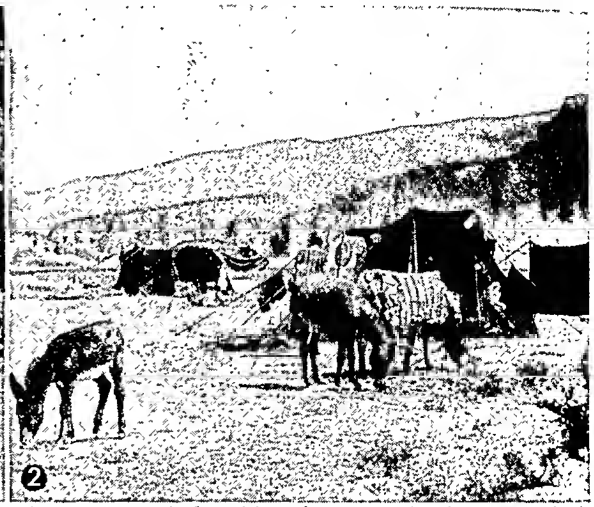
In the following centuries some improvements were made and various conveniences were invented. But no fundamental change occurred until power-driven machinery came into use in the 1800's. This change

PROVIDING SHELTER FROM DANGER

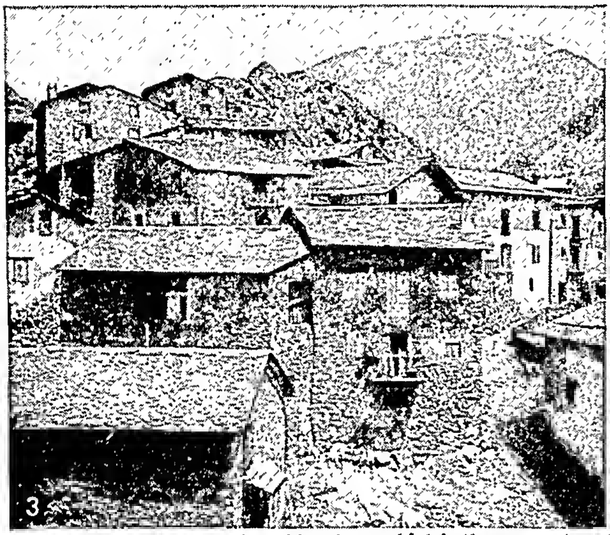


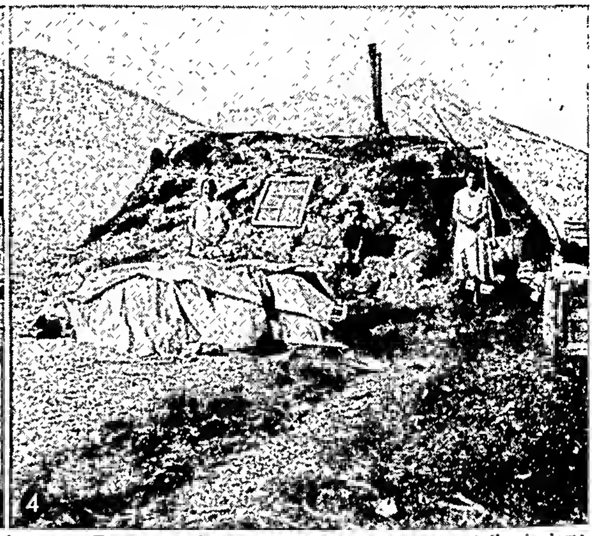
Today most men do not build homes to provide shelter from danger. But in earlier times men needed shelters that would keep out their enemies. 1. The Swiss lake dwellers built their homes over water. 2. The cliff dwellers of the American Southwest made homes like fortresses high up on rock cliffs. 3. During the Middle Ages, the lords built castles of stone and surrounded them with high walls and deep ditches. 4. In North America, pioneers often built log forts or stockades as protection against unfriendly Indians.

HOW CLIMATE INFLUENCES SHELTER

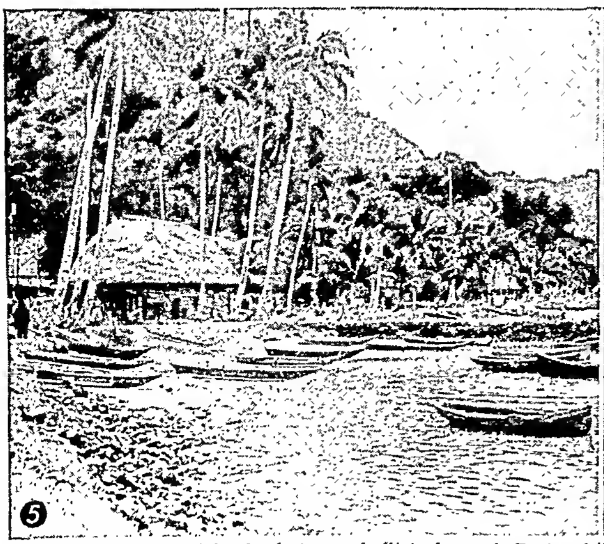


Everywhere men build their homes to suit the climate where they live. 1. A thatched-roof hut gives protection from sun and rain near the equator. 2. In dry desert lands, nomads live in tents. They must move often to find grass for their animals to graze.



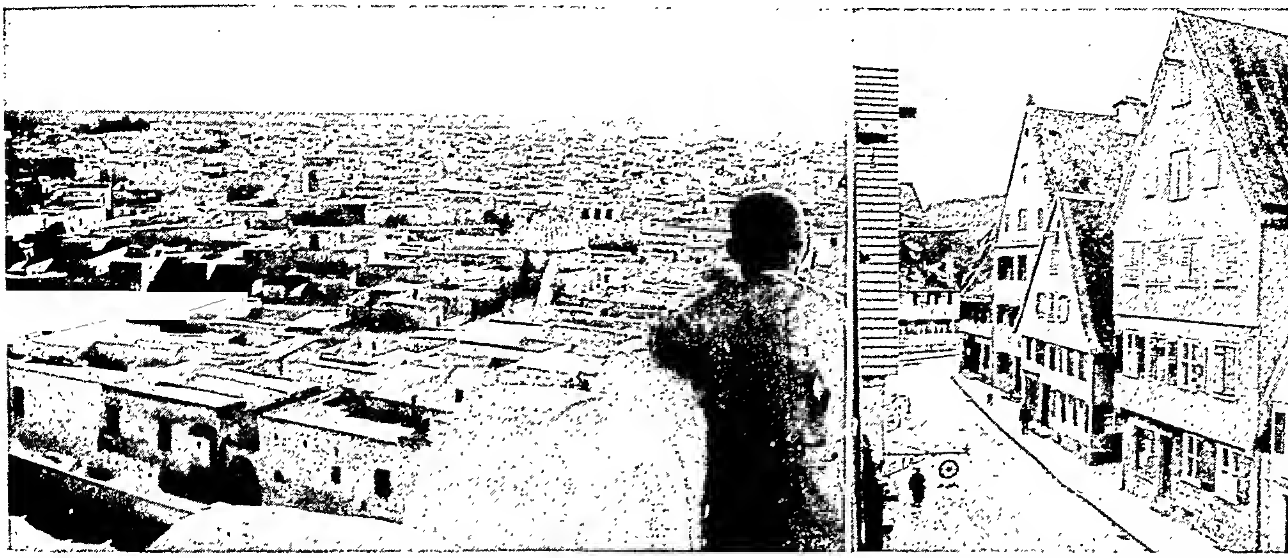


3. Stone houses keep out the cold and snow high in the mountains of western Europe. 4. Many Eskimos of the Far North live in dome-shaped homes made of earth and rocks. These shelters can withstand heavy blankets of snow and strong, biting winds.



5. On warm tropical islands, huts are built to be cool. Parts of the wall can be raised like curtains to let in fresh ocean breezes. 6. In the temperate climate of the United States, farm buildings provide shelter for men and animals.

ROOFS HELP TELL THE TYPE OF CLIMATE



At the left are flat-topped houses in northern Africa. In hot, dry lands many houses have these thick flat roofs to give protection from the sun. Such roofs also offer a cool place to sleep at night. The houses at the right were built in the mountains of Germany. The steep roofs shed heavy snowfall. Rain also slides quickly off such roofs.

revolutionized the production and transportation of building materials. Improved machinery also brought new methods of construction. But the colonists who came to America before this change used the same methods employed in the Middle Ages.

Early Colonial Shelters in America

The first colonists liked to use the same materials and building styles they had known in the mother country. But like earlier peoples, they had to use the materials they found near by. In New England, the first settlers lived in crude shacks made of wattle daubed with beach mud. As soon as they could, they built houses made of rough planks. They built a large fireplace of clay or brick to give warmth. Later, when the colonies were established, well-to-do people built houses of wood like those in England. Wealthy Dutch and German settlers in New York and Pennsylvania chose brick and stone homes because they were familiar with that type.

In the South, English colonists built large wooden houses with many rooms. Some of these were two stories high with porches fronted by pillars. In Florida, the Spaniards built homes of stone and *coquina,* a stonelike material consisting of shells naturally cemented together. In California and the warm, dry Southwest, Spanish colonists who came from Mexico erected houses of *adobe.* This was clay molded into bricks and dried by the sun. These houses had an inner court, a flat roof, and a blank outer wall.

In Canada, the early French settlers built with logs. In New Orleans, they used cypress logs and thatched the roofs with palmetto leaves. Later, the well-to-do in New Orleans built houses of brick and stone. These homes had graceful iron railings and a paved court in the rear (called a *patio*).

One of the most important types of early American shelter was the log cabin. Swedish colonists introduced this type of construction in Maryland and Delaware. When the pioneers pressed steadily westward through forest regions, they built log cabins (*see* Pioneer Life). In the treeless Great Plains region they built houses of sod cut from the prairie.

Transition to Modern Building

Power-driven machinery came into use in the United States in the first half of the 19th century (1800–50). Sawmills, using steam or water power, provided abundant lumber. Nails and other metal products became cheap and plentiful. Steamships, canals, and finally railroads made these materials available in all settled communities at relatively low cost.

HOW AMERICAN PIONEERS BUILT THEIR HOMES

When they settled a new land pioneers usually built houses having only one room. 1. The first settlers in New England made homes of rough planks. The roofs were thatched with rushes. 2. As the pioneers pushed westward through the forests they built log cabins. 3. In the Great Plains region they found few trees. Here they built houses out of sod slabs cut from the prairie.

HOW SHELTER INTERIORS HAVE CHANGED

1. In colonial days people lived close to the fireplace. In this picture a housewife dusts the hearth with a bird's wing. A teakettle and a huge iron pot hang from swinging pothooks over the fire pit. 2. By the late 1800's most houses had a large kitchen. It was the most important room in the house. In cold weather it served as a bathroom, dining room, and living room. 3. In contrast, many kitchens today are small and compact. But every modern tool and cooking utensil is within easy reach of the housewife

These changes transformed building methods. Formerly, families built their own houses, perhaps with help from neighbors. They used materials nearby. Today builders use materials from many places, as shown by the map on the opposite page. They can build in any style the owner desires. Inventors and manufacturers have introduced many conveniences. Among them are heating with furnaces or boilers, and cooking and lighting with gas or electricity, and modern plumbing.

Improvements in Modern Interiors

In early times, shelters usually had only one room. There the family cooked, ate, slept, and kept all its goods. Later, in civilized nations, frontier shelters and homes of the poor still had only one room. These homes often had sleeping space above the rafters or partitioned off along one wall.

Modern homes have several rooms, and each one is designed to serve a particular purpose. This is indicated by its name—kitchen, dining room, living room, bedroom, bathroom, clothes closet, and in some homes a game room, nursery, den, or library.

In large cities many families live in "efficiency" apartments which have only a few rooms. Space is conserved by installing a tiny kitchenette, an in-a-door bed, and sliding wall panels for clothes storage. In contrast, some apartments have as many rooms as a costly house. New apartments and houses may have radiant heating, indirect lighting, and air conditioning. Some have built-in garbage-disposal units, electric dishwashers and other laborsaving devices (*See also* Air Conditioning; Heating and Ventilating; Home Economics and Management.)

The Modern Housing Problem

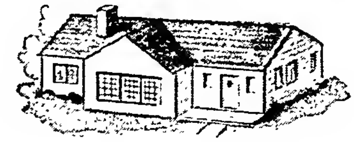
The new conditions also brought financial and social problems. Land had once cost little or nothing, and families had contributed most of the building labor. Later dwellings became more concentrated in

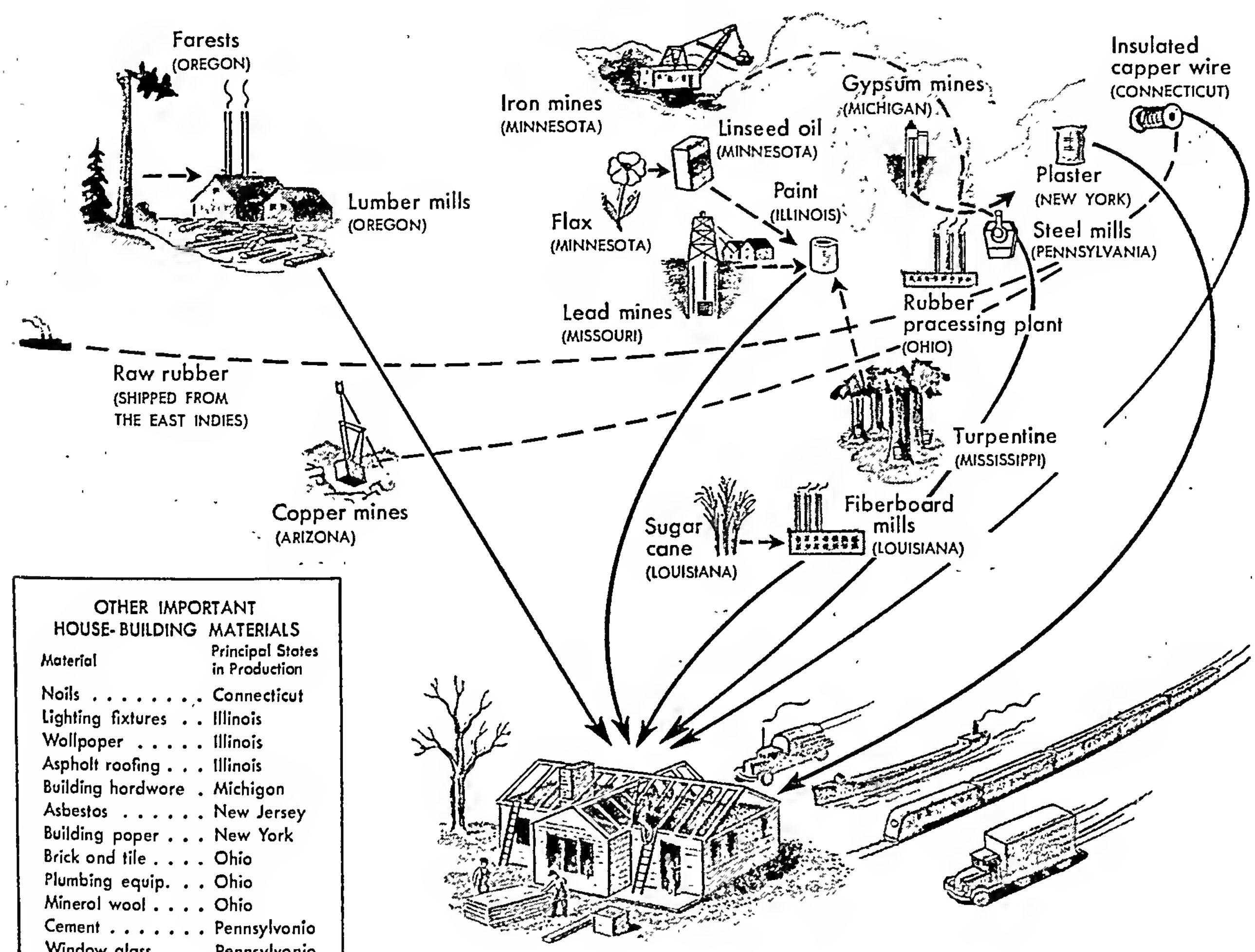
A KITCHEN ON WHEELS

An example of the compact efficiency in modern homes is the kitchen area in a house trailer, or mobile home. This type of shelter is especially useful for retired people and for construction workers and military personnel who move frequently.

Why can we build a house today of many different materials?

Modern means of transportation can bring all types of building materials to any place in the United States.





OTHER IMPORTANT HOUSE-BUILDING MATERIALS

Material	Principal States in Production
Nails	Connecticut
Lighting fixtures	Illinois
Wallpaper	Illinois
Asphalt roofing	Illinois
Building hardware	Michigan
Asbestos	New Jersey
Building paper	New York
Brick and tile	Ohio
Plumbing equip.	Ohio
Mineral wool	Ohio
Cement	Pennsylvania
Window glass	Pennsylvania

Early settlers in America had to build their homes out of wood, stone, or sod. They had to use materials they could transport from nearby sources. The development of modern transportation brought a great change in housebuilding. The map shows how building materials can now be moved quickly by ship, train, or truck to any point in the nation. The states shown above supply many of these products. Some materials, however, might be obtained from states closer to the building site.

towns and cities, and building sites became more expensive. The work of building was transferred to paid craftsmen such as carpenters, bricklayers, plumbers, and painters. Modern conveniences also added to the expense; and communities had to exact higher taxes to pay for the many services provided.

Under these conditions, only those who earned a good income could afford a new house. Many families lived in apartment buildings. These supply shelter for two to 100 or more families. But these accommodations also became increasingly expensive, and rents rose accordingly. Families having low incomes could find shelter only in old or nearly worn-out buildings in undesirable neighborhoods. Many of these localities degenerated into slums. This problem is described in the article on Housing.

REFERENCE-OUTLINE FOR STUDY OF SHELTER AND HOUSING

SHELTER

I. Primitive shelter S-143–4
  - A. Nestlike huts in trees S-142, picture N-143
  - B. Cave and cliff dwellers M-63–4, 70, C-158, C-347–8; picture A-355; color picture M-67
  - C. Lake dwellings M-66, L-87, S-144, color picture M-68, picture S-144*a*

II. Early civilizations S-144, A-305, B-302, B-6
  - A. Greek and Roman houses S-144*a*, A-305–11: Pompeii P-367
  - B. Northern Europe S-144*a*: Northmen N-296

III. Middle Ages S-144*a*: castles C-132–5, pictures J-356, M-238, 238*a*, N-243, B-322, H-261, E-351

IV. Indian shelter in the New World

A. North of the Rio Grande I-94, 100, 104, 104*c*, 104*d*, 106*b*, S-144 (the following references are to pictures): earth lodge I-104, 104*a*; hogan I-104c, A-356; long house I-89; palmetto shelter I-101; pueblo I-92, 104*d*, G-39; slab house I-94, 106c; tepee I-90, 103; tule-thatched hut I-106*a*; wigwam I-99

B. South of the Rio Grande: Aztec huts and houses A-543-4; elaborate Maya structures M-144; Inca farmhouses, picture I-51

V. Shelter in the 13 American Colonies: southern plantations A-193*c*, 193*e*, pictures A-194, 195, A-318; Middle Colonies A-199-200, 203, pictures A-204, A-318; New England A-208, pictures A-207, A-318

VI. Modern shelter: architecture provides refinements A-305, A-318. See also Reference-Outline for Architecture

A. Transition to modern building S-144*c*-*d*: the changing shape of the English house, pictures E-369*f*

B. Modern shelter in the United States, pictures A-322, B-346*b*, U-262, 269, 276, W-308, G-39

VII. Typical shelter around the world, pictures S-143, 144*b*

Note: All references in the following section are to pictures.

A. North America: Greenland (Eskimo) E-393; Newfoundland N-140; Mexico M-197

B. Central America: Costa Rica C-490; Guatemala G-222*a*, *c*, C-174; Honduras H-417, C-171; Panama P-52, P-55.

C. South America S-260: Argentina (Tierra del Fuego) S-259; Bolivia B-222*b*; Brazil B-287; Chile C-254; Colombia C-389; Paraguay P-76; Peru P-163, L-115

D. Europe: Belgium B-116; England E-349, 353, E-364, S-68, A-317; France F-258, 266, 271; Germany S-144*c*, B-82, 83; Ireland I-228; Italy I-264, 266; Lapland L-102; Netherlands N-115; Norway N-303; Portugal P-381; Russia R-263; Scotland S-62; Spain S-314, 316, 319*a*, 320; Sweden S-463; Switzerland S-474, 476, 478

E. Asia A-403: China C-258, 263, C-116; East Indies E-204, 205, J-325; India I-64, H-356; Indo-China I-126; Japan J-298, Malay Peninsula M-57; Mongolia M-344; Palestine P-44; Philippines P-196; Samoa P-12; Siam S-169; Syria S-487; Turkey T-215, 217

F. Africa S-144c: Congo A-50, C-434*c*, 434*d*; Morocco M-394; Nigeria A-49; Rhodesia A-49, South Africa S-244

G. Australia: cities A-481; stations A-483 (text)

HOUSING

I. In the United States H-430-3, S-145, B-346*b*, pictures S-142, 143, 144*b*, U-269, A-322, B-346*a*, 347, W-308 See also Housing in Fact-Index

A. Causes of the housing shortage H-430-430*a*

B. Problems created by slums H-430*b*-431*b*, pictures H-431c, 431*d*, U-312: clearance H-432*e*-433

C. Problems of home ownership H-432*b*

D. Attacking the housing problem H-432*e*-433, S-145, U-368, B-345: Roosevelt "New Deal" agencies (FHA, HOLC, NHA), list R-205, picture R-208; Truman "Fair Deal" program (public housing and slum clearance bill) T-200, prefabricated houses B-346*b*, H-432*d*, pictures B-347

E. City planning C-321, pictures C-322. See also City Planning in Fact-Index

II. In Europe H-433: England E-351, L-306; Sweden, pictures H-433, S-463; Norway O-426*b*; Russia L-164

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(*See also* bibliography for Architecture.)

SHERIDAN, GENERAL PHILIP HENRY (1831–1888). "Fighting Phil Sheridan" ranks with Generals Grant and Sherman as one of the three great Union commanders of the Civil War. He was the only one of the three who devoted his whole life to the army.

Sheridan was born in Albany, N. Y., where his parents had settled after emigrating from Ireland. Soon after his birth the family moved to Perry County, Ohio. Here his father worked on canals and roads while the boy attended school. The Mexican War prompted Sheridan to become a soldier. He secured an appointment to West Point and was graduated from there in 1853. His first experience in warfare was gained against the Indians in Texas and Oregon.

At the outbreak of the Civil War he was a first lieutenant. Distinguished service brought him rapid promotions. He won praise for his leadership in the battles of Perryville, Ky., Stones River, Tenn., Chickamauga, Ga., and Chattanooga, Tenn. At the battle of Missionary Ridge, Sheridan was one of the first to reach the crest. When Grant took command of the United States Army in 1864 he gave Sheridan command

of the cavalry of the Army of the Potomac. During the Wilderness campaign of 1864 Sheridan aided Grant by destroying Confederate lines of communication.

In July 1864, a strong Confederate force under Jubal Early drove the Federal army from the Shenandoah Valley in northwestern Virginia. Sheridan then took command of the area. He defeated Early at Winchester and again at Fisher's Hill, driving the Confederates back to Staunton. This won Sheridan a commission as brigadier general in the regular army.

On the morning of October 19 Early counterattacked at Cedar Creek and drove the Federal force back in confusion. At the time Sheridan was returning from a conference in Washington. According to the poem 'Sheridan's Ride' by Thomas Read, the general had reached Winchester, 20 miles away, when he heard:

> The terrible grumble, and rumble, and roar,
> Telling the battle was on once more.

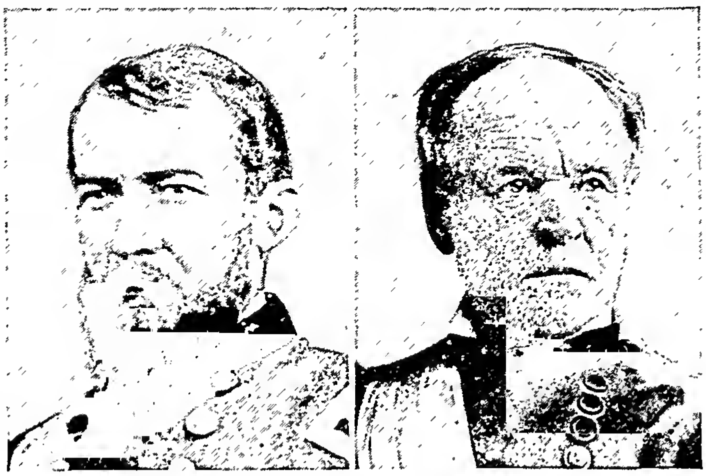
Speedily he rode forward and reorganized the Union troops. At 3:00 P.M. his forces attacked and drove the Confederates 30 miles up the valley. For this Sheridan was made a major general and received the thanks of Congress. Although the poem has been criticized as inaccurate, it does express the public admiration of Sheridan's leadership. A spirited statue by Gutzon Borglum in Washington and others elsewhere show Sheridan on horseback rallying his men.

For three war years the Shenandoah Valley had been a rich storehouse for the Confederates. But now Sheridan ravaged the land until, as it was said, a crow flying over it would have to carry its own rations. In March 1865 Sheridan rejoined the Army of the Potomac. At Five Forks he entrapped and routed Pickett's troops, causing the Confederates to abandon Petersburg. When Lee started to retreat Sheridan's cavalry blocked the Confederate escape route at Appomattox Court House. This forced Lee to surrender.

After the war Sheridan was placed in command in the Southwest near the Mexican border. Later he headed the Department of Missouri, with headquarters in Chicago. During the great Chicago fire of 1871, Sheridan's troops helped maintain order in the city.

In 1870 Sheridan served as the American military observer with the Prussian army in the Franco-Prussian War. In 1884 he succeeded Sherman as commander in chief of the United States Army. He received the rank of general a few months before his death. He was the last to hold this rank until it was conferred on Gen. John Pershing in 1917.

THEY HELPED BRING VICTORY TO THE NORTH



The officers who gave the most help to General Grant in the Civil War were Gen. Philip Sheridan (left) and Gen. William Sherman (right). Both men hastened victory by devastating Confederate territory.

SHERMAN, GENERAL WILLIAM TECUMSEH (1820–1891). Second only to General Grant as the greatest Northern commander in the Civil War was William Tecumseh Sherman. Like Grant, Sherman was born in the then frontier state of Ohio, at Lancaster. He was named Tecumseh for the Shawnee Indian chief who had terrorized that region a few years earlier.

Sherman's father, a judge on the state supreme court, died when the boy was nine years old. Most of the 11 children in the family were distributed among the relatives and friends of the family. The future general was reared by Thomas Ewing, a Lancaster lawyer. Ewing renamed him William Tecumseh.

After attending an academy at Lancaster, Sherman entered West Point. He was graduated from there in 1840, sixth in his class. He received a commission in the army and during the Mexican War saw service in California. By 1853 he was tired of military life and resigned his commission to enter on a business, legal, and educational career.

At the opening of the Civil War he was head of the state military academy of Louisiana (now Louisiana State University). But his sympathies and duty lay with the North. Resigning his position, he hurried to Washington, D. C., to rejoin the army. He was commissioned a colonel of volunteers and commanded a brigade in the first battle of Bull Run, July 21, 1861. In August he was promoted to brigadier general and two months later he was given charge of the Department of the Ohio (River).

On taking over his new command he reported to Washington, D. C., that 200,000 men would be needed to carry on a successful campaign in that region. The North at that time had no idea of the task that lay ahead, and newspapers said that Sherman was "crazy." Time proved that his estimate was correct but he was sacrificed to the popular clamor against him and removed from his command.

But Sherman's military genius was so great that he could not long be kept in the background. At the battle of Shiloh, April 6, 1862, he was in the thick of the fight. He had several horses shot from under him and was twice wounded, but he helped save the day for the Union army. For his services he received the rank of major general. Serious mistakes had been made at the battle of Shiloh, and the commander, Grant, had to endure much criticism. Grant wished to withdraw from the army entirely, but Sherman persuaded him to stay, reminding him of the storm of criticism he himself had weathered.

Sherman did more than talk. He backed up his words with deeds, and in the Vicksburg campaign rendered valuable aid to Grant. At its successful conclusion he generously gave all the credit to his superior officer. When Grant, as a result of this campaign, was made commander of the armies of the United States, Sherman was appointed to fill Grant's position as commander in the West.

His Most Famous Campaign

It was in this position that he carried on the campaign on which his fame chiefly rests. On May 6, 1864, he left Chattanooga, Tenn., for Atlanta, Ga. It took him four months to cover the 135 miles between the two places, for in this campaign he met a foeman worthy of his steel in Gen. Joseph E. Johnston, the Confederate commander. Difficulties were about evenly balanced, but Sherman possessed the love and confidence of his men to a much greater degree than did his opponent. They knew that when they saw "Uncle Billy and his white socks" all was well.

Atlanta was reached on September 2. After clearing the city of its civil population and resting his men, Sherman started on his famous march of 400 miles "from Atlanta to the sea." For 32 days no news of him reached the North. He had cut himself off from his base of supplies, and his men lived on the country through which they passed. They covered a path 60 miles wide in their march, and in that path everything which they could not use but which might prove of use to the enemy was ruthlessly destroyed. When we consider this destruction is it any wonder that Sherman said that "war is hell"? Finally on December 20, Savannah, Ga., was reached and Sherman telegraphed to President Lincoln: "I beg to present you as a Christmas gift the city of Savannah, with 150 heavy guns and plenty of ammunition, and also about 25,000 bales of cotton."

The Surrender of Johnston

After a month's rest Sherman turned North with his army, expecting to join Grant near Richmond, the Confederate capital. But before he reached that place the Confederacy had collapsed. After receiving the surrender of General Johnston in North Carolina, Sherman marched on to Washington. He thus completed a march of nearly 2,000 miles through the enemy's country, one of history's greatest campaigns.

Having achieved such fame in the army, Sherman decided not to return to civil life. He remained as commander in the West until Grant was elected president. He was then made commander of the United States Army and given the rank of general, a rank which previously had been held only by Grant. He held the command of the Army until 1884, when he resigned, after 23 years of continuous army service.

SHETLAND ISLANDS. In that far-away time when the Shetlands were inhabited by a short dark people called the Picts, the Romans named the islands *Ultima Thule*, "the farthest land," or end of the world. But to the Vikings of Norway and Sweden these islands were near neighbors, easily visited in their long boats. Everywhere we see reminders of those days—burial mounds, stone circles for Druid rites, crumbling stone watch towers.

These islands are a region of fogs, storms, and long winters, where little except potatoes, oats, and barley can be grown. The islanders live principally by fishing, but they also raise Shetland ponies, a small breed of cattle, and sheep. They make excellent knitted goods and tweeds from native wool. Hard as their life is, it yet has the compensation of ruggedly beautiful surroundings. The ocean is everywhere, dashing against brilliantly colored cliffs, and so penetrating the land by firths that no point is more than 3 miles from the sea. A striking natural feature is the Grind of the Navir, or Gate of the Giants, carved by waves from the porphyry cliffs.

The Shetland group contains more than 100 islands and islets, with a land area of 550 square miles. The largest is Mainland, with about two-thirds of the total area. On Mainland is the capital, Lerwick. The group lies 120 miles northeast of the Scottish mainland, and 200 miles west of Norway. It was ceded by Norway to Scotland in 1468 and forms a Scottish county. Population (1951 census, preliminary), 19,343.

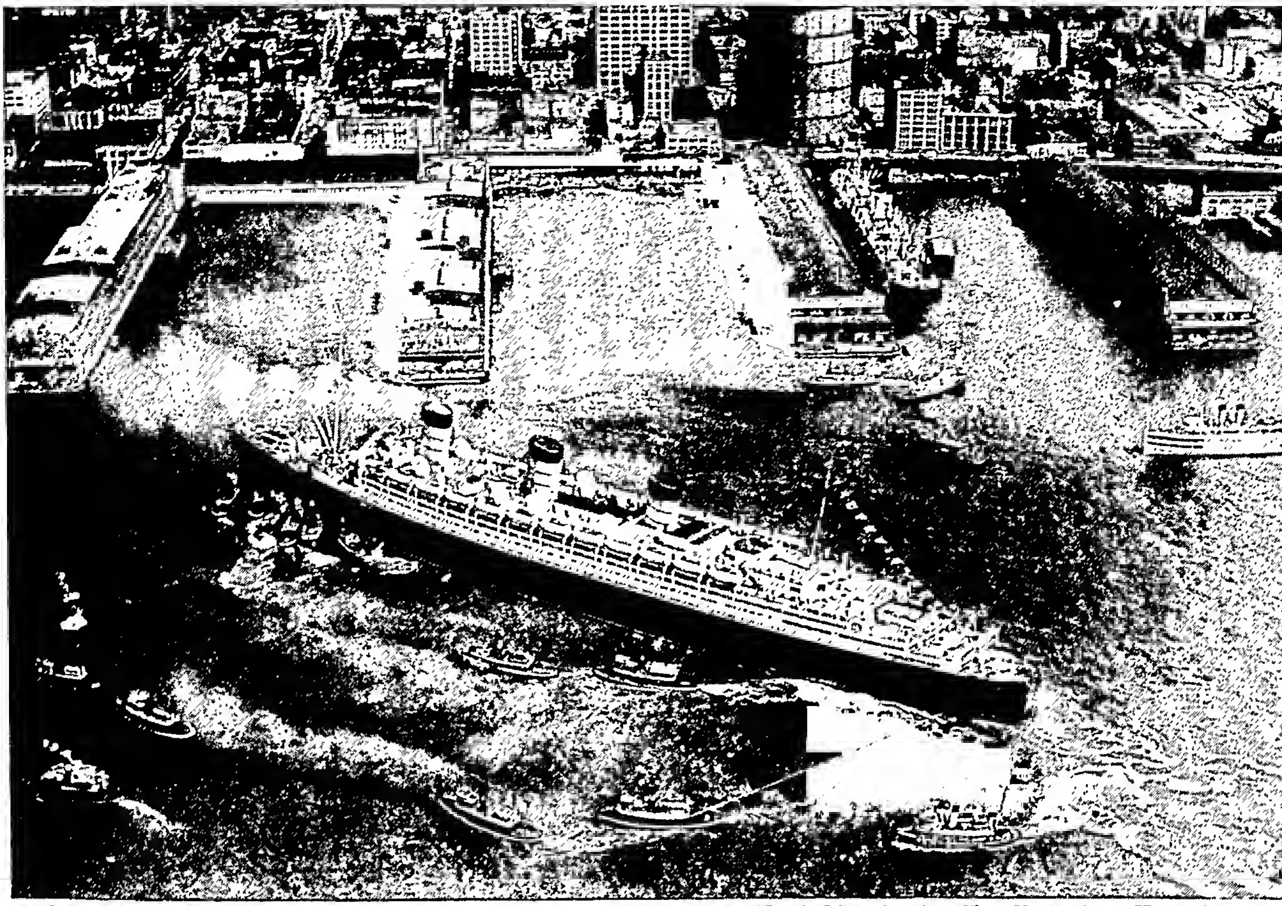
SHILOH (*shī'lō*), **BATTLE OF.** On Sunday morning, April 6, 1862, General Grant sat enjoying a leisurely breakfast below Pittsburg Landing on the Tennessee River, while his army cooked breakfast in the camps grouped about Shiloh church not far away. Nobody expected trouble from the retreating Confederate forces under Gen. A. S. Johnston supposed to be camped at Corinth, 20 miles away; Grant had not kept cavalry out watching the Confederates, nor had he posted outposts sufficiently far in front.

Suddenly the crack of rifles and roar of battle broke the calm. When Grant reached his troops, his situation looked disastrous. The Confederates in full force had burst from covering woods and were driving desperately resisting bands of Union soldiers from their camps. All day the battle raged, with terrific losses; practically no control could be exercised by either commander over his raw troops. By night, the Union troops had been driven almost to the river.

The situation changed over night. General Buell arrived with 25,000 Union troops, and General Johnston of the Confederates died of a wound he had suffered while leading a charge. His successor, General Beauregard, was driven from the field next day and retired to Corinth. The Union armies of some 70,000 lost about 13,000 killed and wounded. The Confederate loss was 10,000 out of some 40,000.

Shiloh was the second great battle of the Civil War and the most bitterly fought engagement of the whole struggle. Bitter criticism was heaped upon Grant for his heavy losses. But President Lincoln refused to remove him, and Grant soon justified the president's faith in him. The Confederates, on the other hand, had lost almost as heavily and had missed their chance to break up the Union advance in the West.

OAR, SAIL, *and* STEAM—*The* STORY *of* SHIPS



A fleet of powerful tugs chug and strain to ease the huge *Queen Mary* into a North River berth at New York City. Henry Hudson's ship, the *Half Moon,* which sailed across the Atlantic and passed this spot in 1609, was smaller than any of these tugs.

SHIPS. A stout ship can go wherever there is enough water to keep it afloat. For this reason ships have been important to men since long before the dawn of history. Wagons, motor vehicles, and railroad trains must have roads or tracks to travel on. A ship needs nothing but water. Rivers, lakes, seas, and oceans are highways for a ship. And these "highways" are far more extensive than those on land, for nearly three-fourths of the earth's surface is covered by water.

From the time men first began to build ships they have wanted two qualities: roominess and speed. Above all else, a ship must be able to float and support a load. Buoyancy (floating power) depends largely on the relative size of the hollow space inside the hull; and a round shape gives the largest hollow space for a given size of hull. Hence, ships built for cargo carrying have always tended to be tubby. The "round ships" of ancient times, with crude sails, were so clumsy that they could make only a mile or two an hour.

A ship should also steer well and ride well over waves; and, at least for war, it should be speedy. The best kind of ship for these purposes is a long narrow ship. Such a ship also needs a deep keel, or "fin," below so that in a rough sea it will not roll over like a log. Ancient people used sails on these "long ships"; but they relied principally upon oars, because oars gave greater speed and made maneuvering easier. Both round and long ships are still built. The contrast between them can be seen by comparing a typical broad-beamed cargo vessel with a modern destroyer or ocean liner.

The First Ships

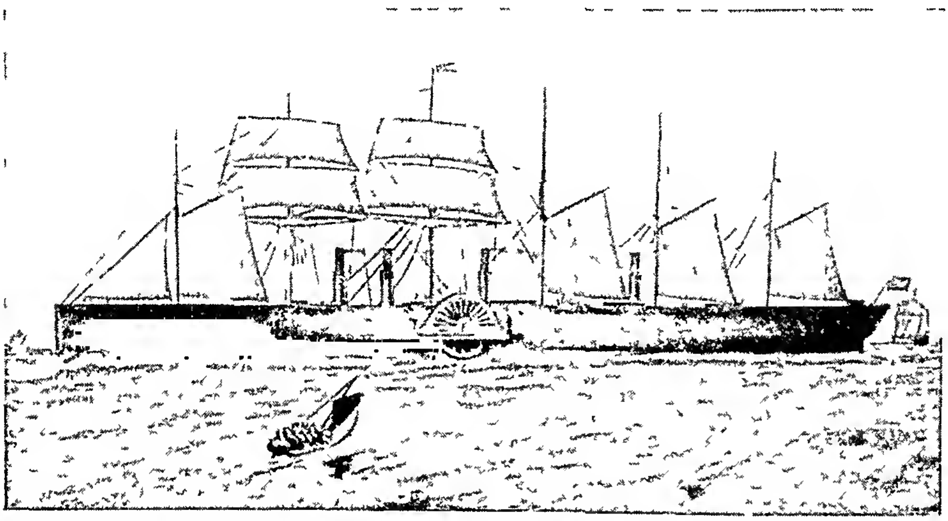
Men have had ships from the most ancient times. The first "ship" was made when some primitive man discovered that a tree trunk or branch would hold him up in the water. Others living in treeless lands learned to use bundles of rushes tied to form a rough boat. Still others used baskets or inflated skins as boats. In some parts of the world people still use such craft (*see* Boats).

But hollowed logs and inflated skins are not ships. Real shipbuilding began when men learned to fasten planks and timbers together into a vessel of some size. The Egyptians made this discovery before the Pyramid Age. The Sumerians of Mesopotamia and the inhabitants of ancient Crete and China probably learned how to build ships at about the same time. Real ships are pictured in Egyptian paintings of the 28th century B.C. The Cretans also built ships for sailing the Mediterranean at a very ancient date (*see* Aegean Civilization). But the greatest sailors of ancient times, after about 1200 B.C., were

the Phoenicians. Their war galleys carried sharp beaks for ramming enemy craft, and had two or more banks of oars for greater power and speed. From this model the Greeks and Romans developed their "biremes," with two banks of oars, "triremes," with three banks, and great round ships for cargo work. Such ships were used in the Mediterranean until the Crusades.

During the early Middle Ages the Scandinavians made a great advance in seafaring. They undertook bold voyages on the Atlantic in their long, beautifully shaped "serpents" and "dragons," with one great sail and one bank of oars (*see* Northmen). This type of vessel was combined with Mediterranean types during the Crusades, and improvements were invented. Instead of a steering oar hanging over the right side (whence *starboard*, from "steerboard," the right side), the steering blade, now called a *rudder*, was hinged at the stern, where it would not pull out of water when the ship rolled. It was turned with a tiller, or bar handle, until the steering wheel was invented in the 18th century. Sails were improved until oars could be dispensed with, except on the large Mediterranean war galleys and trading ships used on long voyages. "Castles," originally erected fore and aft as posts for archers, became the permanent "forecastle" and "after castle" of the ship. These castles were used for living quarters, and also kept great waves from sweeping the decks.

AN EARLY LEVIATHAN, THE 'GREAT EASTERN'



The *Great Eastern* (originally called the *Leviathan*), a paddle and screw steamship launched in 1858, was for many years the largest ship in the world. It was nearly 700 feet long, 83 feet broad, and 60 feet deep. It was far in advance of its time, and was never a financial success.

The Great Voyages of Discovery

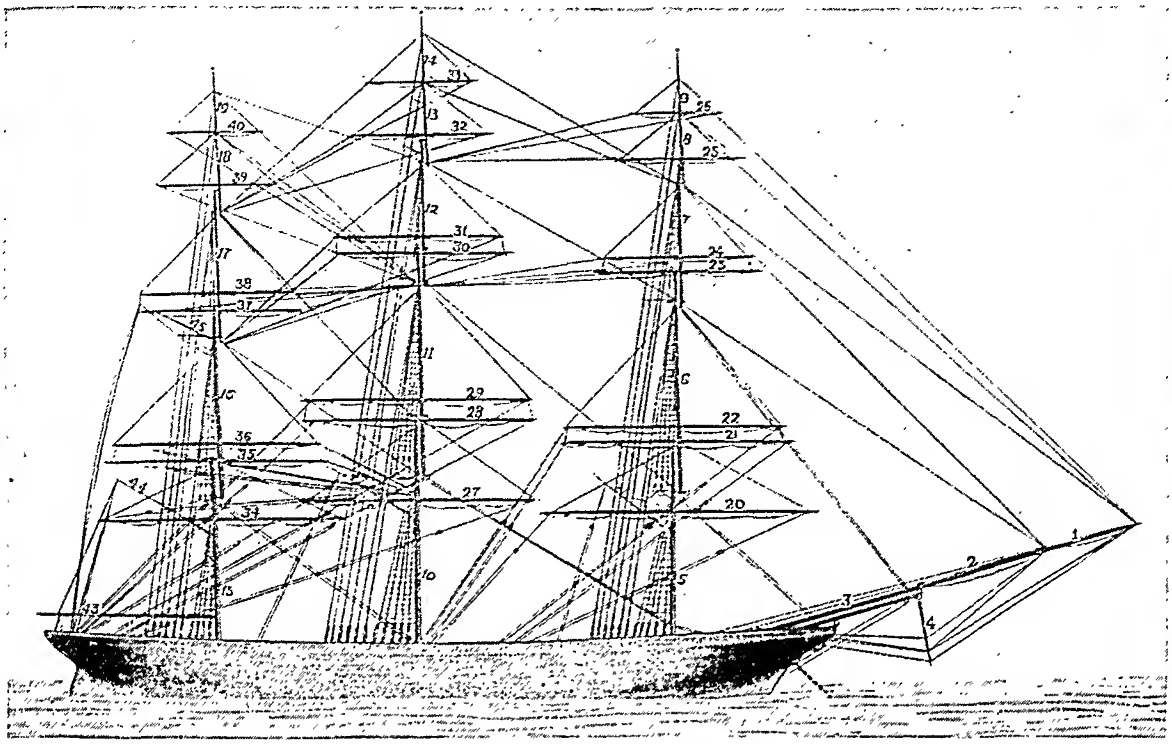
These improvements came in the same period when Mediterranean navigators learned to use the magnetic compass (*see* Compass, Magnetic; Navigation). Men now were equipped to sail the high seas; so the mariners of Genoa and Portugal, and later of Spain, sought sea routes to the Orient (*see* America). In the north, the Hansa towns were active; later England and Holland took to the sea.

As England grew to be the "mistress of the seas," sails, used more skilfully by English seamen than by their predecessors, became the only motive power for merchant and naval vessels alike. Craft that would be recognized by a modern sailor began to appear on the seas—full-rigged ships in the modern technical sense, brigs, barks, etc. High-water mark in the development of the sailing vessel for beauty and speed was attained, however, not by British vessels, but by the famous "Yankee clippers" of the 1840's and '50's. Previously the hulls of merchant ships had been constructed for capacity rather than speed. The loss and ruin sometimes incurred in the East India and China trade through market changes or deterioration of cargoes on long voyages stimulated the construction of a new type—a long slender vessel, at first small, but later from 135 to over 300 feet long—with fine lines, sharp bows, towering masts, and an immense spread of square-rigged sails, which slid or "clipped" instead of pounding through the water by main force. This was a distinct type from the long, low, rakish, and comparatively small craft —60 to 125 feet long—with full round bows and sails, sometimes square and sometimes schooner-rigged, which had won renown in the War of 1812 as the Chesapeake or Baltimore clipper. The true Yankee clipper rejoiced national pride by making speed records seldom equaled before or since by any sailing vessel; 300 miles a day was not exceptional.

Decline of the Sailing Ship

Yet the heyday of the Yankee clippers was brief. They were doomed by the steamships, which were beginning to ply the ocean in greater and greater numbers. Fleet and beautiful, they marked the closing chapter in the long and glorious era of the supremacy of sails and wood upon the seas.

But sailing vessels continued to play a minor rôle in the performance of the world's work. The square-rigger virtually disappeared, and the schooner took its place. Fore-and-aft rigged, with two, three, or more masts, schooners can sail much closer to the wind than square-rigged ships, and can be worked with smaller crews. Schooners were employed chiefly in fisheries, in the coasting trade, on inland waters, and as carriers of heavy freight such as lumber, ore, and coal. The United States at present has the



A FULL-RIGGED SHIP

Sailing ships may be divided into three distinct classes—the square-rigged, the fore-and-aft rigged, and the mixed-rigged. The square-rig, which is illustrated above, consists of sails hung from horizontal yards, which are slung at their middle points to the masts. The masts are held in place by shrouds attached to the ship's sides, and by stays between the masts and forward. A full-rigged ship —a "ship" in the technical sense—has three masts, all square-rigged, called from bow to stern the foremast, the mainmast, and the mizzenmast. A "brig" has only two masts, the fore and main.

A full-rigged ship may carry five or more sails, one above the other, on each mast. The same names are applied to the corresponding sails and spars on each mast, except that the name of the mast is prefixed. In describing the rigging of a ship we shall refer to the foremast, but in every case in which a corresponding spar is used on the main or mizzenmast the number of the corresponding spar will be given, so that you can locate, for example, the fore topmast (6), main topmast (11), and mizzen topmast (16).

Each mast comprises five separate parts or masts. The bottom one is called the foremast (5), mainmast (10), or mizzenmast (15) as the case may be, and the upper ones, in order, are the topmast (6, 11, 16), the topgallant mast (7, 12, 17), the royal mast (8, 13, 18), and the skysail mast (9, 14, 19).

Square-rigged ships usually carry a set of triangular sails called jibs, hung on stays strung from the foremast to a jibboom (2), and to a flying jibboom (1), which project from the bow. Below these spars is a boom called the dolphin-striker (4); it supports the stays and martingales that brace the jibbooms from below. The bowsprit (3) supports the jibboom. Other triangular sails, called staysails, are rigged on the stays between the masts.

The lowest yards are called the foreyard (20), the main yard (27), and the crossjack (34). They carry the foresail, the mainsail, and the mizzen sail or crossjack. These sails are often called courses. Next above these are the lower topsail yards (21, 28, 35), then the upper topsail yards (22, 29, 36), the lower topgallant yards (23, 30, 37), the upper topgallant yards (24, 31, 38), and the royal yards (25, 32, 39). The topmost yards are the skysail (26, 33, 40). On the mizzenmast are a number of special arms—the spanker boom (43), the spanker gaff (44), and the monkey gaff (45).

The fore-and-aft rig consists of one large sail to the mast. This may be spread between a horizontal boom at the bottom and a shorter gaff above. The gaff is a spar fastened to the mast by a collar; it points midway between horizontal and vertical, and can be raised and lowered by halyards. The sail swings to one side or the other of the mast, or directly back of it ("aft"). Such sails can be handled from the deck, so that a large vessel may be manned by comparatively few men.

The single-masted "fore-and-after," with a gaff mainsail and a jib, is called a "sloop"; with two or more masts, and a jib, a "schooner." A sloop with a smaller second mast is called a "yawl."

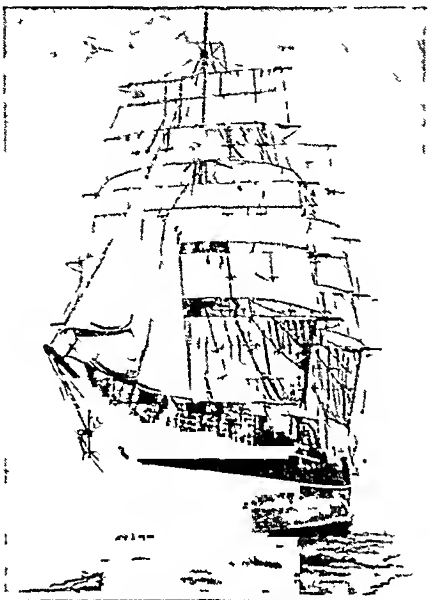
Vessels with mixed rigs, the third class, carry both square and fore-and-aft rigging. A two-master with square rigging on the foremast, and fore-and-aft rigging on the main, is a "brigantine." A threemaster with square rigging on the fore, and fore-and-aft rigging on the other two, is a "barkantine"; if only the mizzenmast is rigged fore-and-aft, it is a "bark" or "barque."

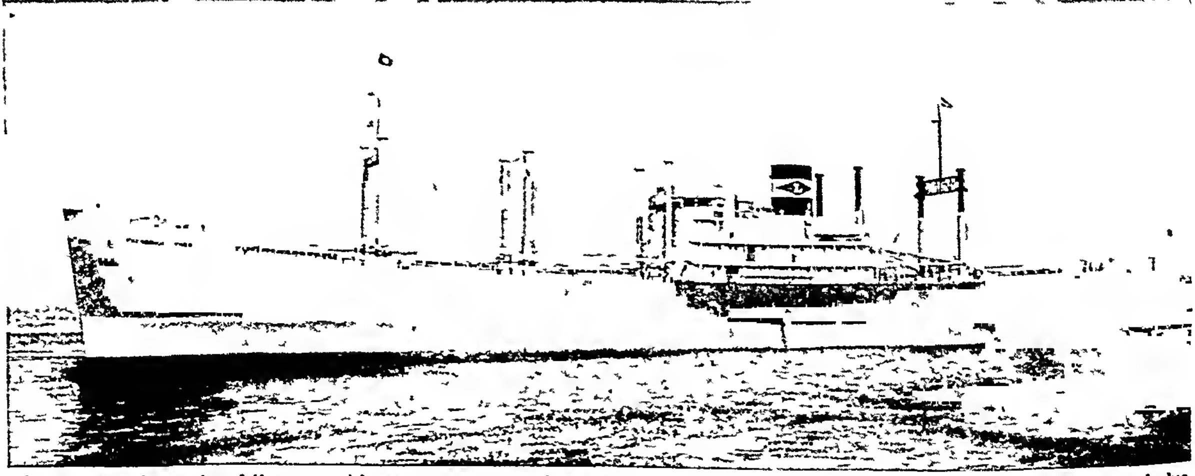
largest sailing tonnage of any country in the world, though some other maritime nations have greater numbers of ships.

Development of the Steamboat

In the closing decades of the 18th century many experiments were made with steam propulsion of boats. Twelve years after Fulton's *Clermont* made its first voyage on the Hudson (*see* Fulton, Robert), the first vessel fitted with steam power crossed the Atlantic. This was the American built *Savannah* which in 1819 ran from Savannah to Liverpool in 25 days, most of the time, however, under sail. The engines of those days consumed about four times as much fuel as modern engines for every horsepower produced, so the problem of a transatlantic steam passage was a fuel problem. The *Savannah's* voyage and the one or two transatlantic passages made by steam vessels in following years made such slight impression that in 1835 "sober sensible people" hooted at the suggestion of a steamship line between Great Britain and North America; one might as well talk of running a steamship line to the moon, they said. And a boat from the moon could scarcely have created a greater sensation in 1838 than the arrival, on April 22, in New York harbor of the *Sirius*, which had made the run from Cork in 17 days entirely under steam power. The following day the *Great Western*, the first steamship built for transatlantic service, arrived from Bristol. And now the transatlantic steam liner was an accomplished fact, and before long the "seven seas" were netted with steamship lines. The only one of the early transatlantic lines to survive, however, was the Cunard line, founded in 1839. The White Star, which merged with the Cunard line in 1934, was originally a sailing line. Its first steamship crossed the ocean in 1870.

SAIL AND STEAM



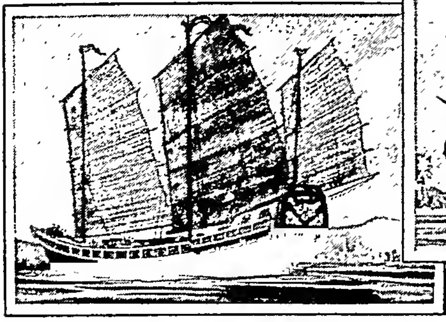


Here we see the past and the present in seagoing vessels. In the stately bark *Discovery*, at the top, Capt. Robert F. Scott made his first attempt to reach the South Pole. The *Frederick Lykes*, in the lower picture, is a modern cargo vessel of the type designated C-3. It provides fast cargo service on regular runs and carries a limited number of passengers. Passengers' staterooms and officers' quarters are confined to the small superstructure at the waist of the ship. This arrangement allows maximum space for cargo holds.

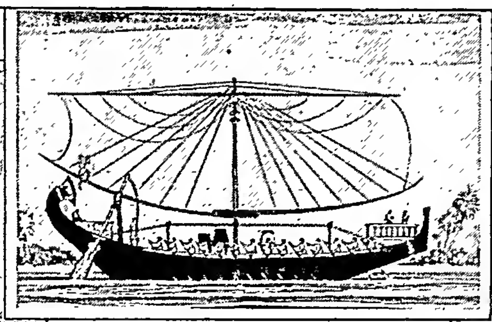
Speed of Steamships and Sailing Vessels

The fastest sailing vessels as a rule made the voyage from Europe to America in several weeks. One sailing vessel made the passage from Liverpool to Baltimore in 14 days 9 hours. Less than a hundred years from the time of the *Savannah's* voyage the fastest steamships were to make it in four and a half days. The first transatlantic steamships, to be sure, were not infrequently beaten in races with the swift sailing packets. Even today, the hourly speed at which it is found most profitable to run ordinary freight steamships—9 to 12 nautical miles—is no greater than that of the clipper ships—12 to 15 miles—and far below the record clipper speed—21 miles. It is only our great luxurious passenger liners, which disdain freight almost altogether, that make speeds of from 25 to 30 nautical miles an hour. Yet, from the first, commerce tended inevitably to flow in the channels provided by the new steamship lines; and today the London merchant gets tea from China in five weeks by steamship, whereas the fastest of the tea-clippers took at least three months. Voyages by steamship take far less time than sailing-ship voyages, even though there may be no great difference in the speed of the two kinds of ships through the water. The big advantage of steam is its freedom from delay due to adverse weather conditions and its ability to take

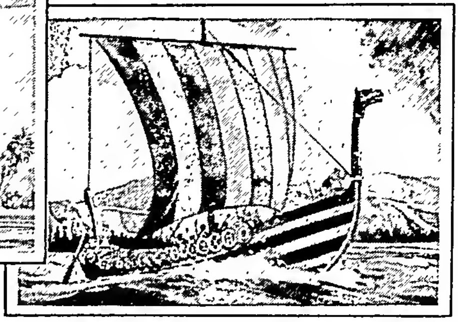
SAILING SHIPS THROUGH THE CENTURIES



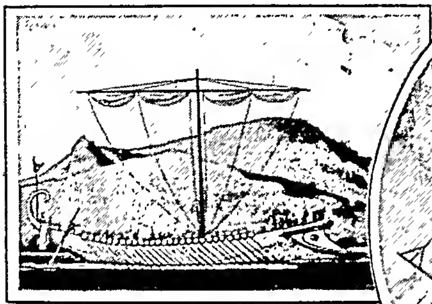
CHINESE JUNK



EGYPTIAN SHIP - 1600 B.C.

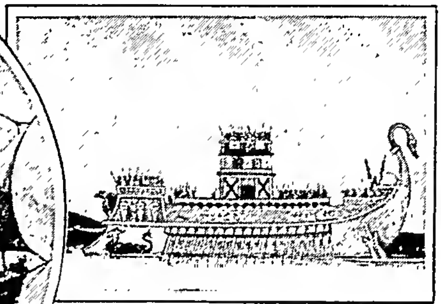


VIKING SHIP - 1000 A.D.

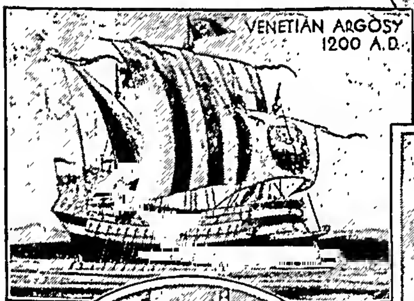


PHOENICIAN GALLEY - 450 B.C.

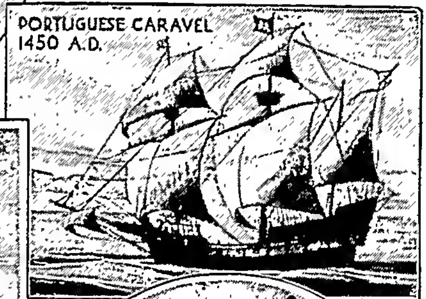
SPANISH GALLEON - 1580 A.D.



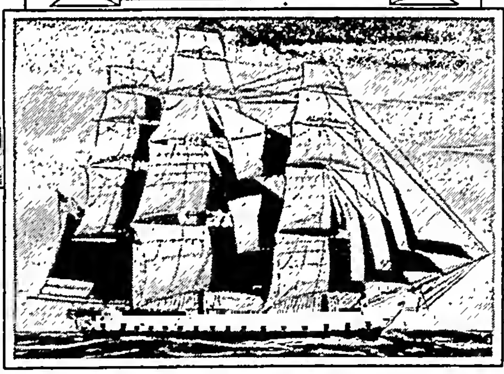
ROMAN TRIREME - 100 A.D.



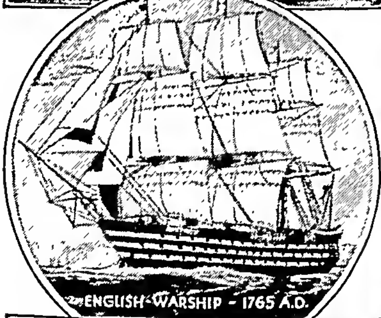
VENETIAN ARGOSY 1200 A.D.



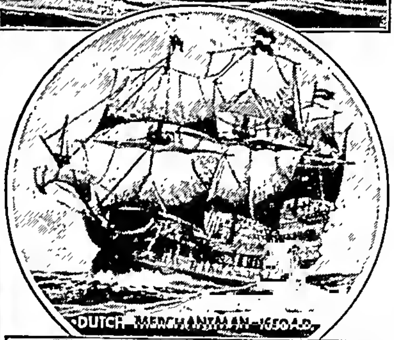
PORTUGUESE CARAVEL 1450 A.D.



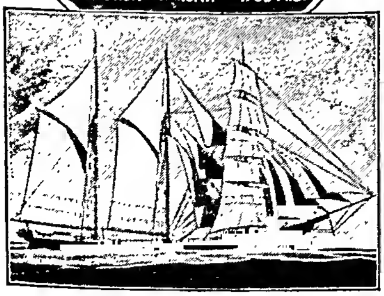
AMERICAN FRIGATE CONSTITUTION - 1800 A.D.



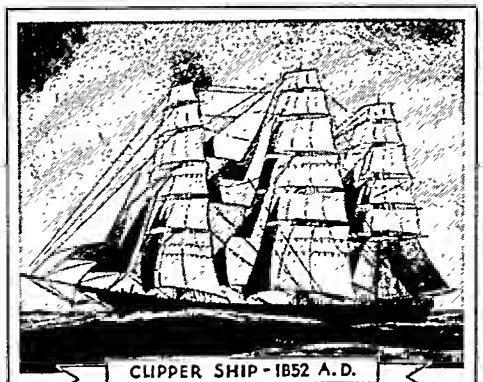
ENGLISH WARSHIP - 1765 A.D.



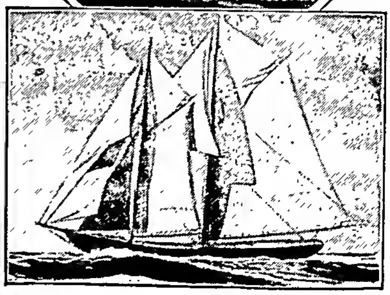
DUTCH MERCHANTMAN - 1650 A.D.



BARKANTINE - 1840 A.D.



CLIPPER SHIP - 1852 A.D.



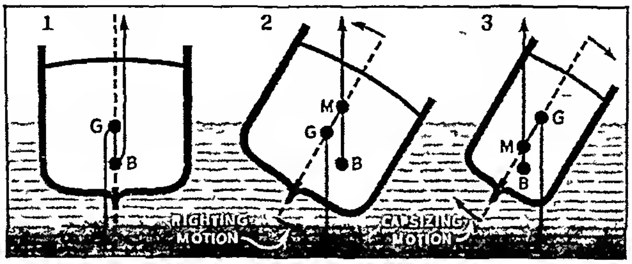
FISHING SCHOONER - MODERN

From the hollowed-out log canoes of the first adventurous voyagers by water, to the graceful swift clipper-ships of the 1850's, stretches a span of time that we cannot even guess. But during those thousands of years, with all their ingenious development of form, there were only two methods of propulsion—first oars, then oars and sails or sails alone. In the pictures above are many of the types of ships developed before the coming of steam navigation at the beginning of the 19th century. The Chinese junk is undated because there has been little change in its design for 2,000 years or more. Note the development of rigging, from the simple sails of the early Egyptians and Phoenicians, and even the Vikings, to the fine billowing sails of the frigate *Constitution* ("Old Ironsides") and the fast-speeding barkantine and clipper ship, almost the last champions of sail on the high seas.

was adapted to marine use and the screw propeller was adopted on most ships. Twin screws came later; today some vessels have three or even four screws.

Later, more efficient and economical power was obtained with triple-expansion engines and finally with the turbine (*see* Turbine). The first steamship to have a turbine was the experimental *Turbinia*, in 1897. In 1907 the *Mauretania* was completed with these engines and proved sensationally speedy. It made some crossings between New York and Europe at better than 26 knots, or more than 30 statute miles an hour. The *Mauretania* remained speed champion of the North Atlantic until the German ship *Bremen* beat it in 1929. Such successes made turbines the favorite engine for the largest and heaviest ships. In some modern ships the turbines are used to generate electric power instead of driving the ship directly. Early in the 20th century, steamships met a rival in the motor ship, equipped with Diesel engines (*see* Diesel Engine).

WHY A SHIP RIGHTS ITSELF OR CAPSIZES



A ship's ability to right itself depends upon the relations between the center of gravity (G), where the ship's weight draws it down, and the center of buoyancy (B), where the water supports the ship. In an upright ship (1), these centers lie on the midline. When a ship rolls, the center of buoyancy shifts sidewise and thrusts upward across the midline at a point called the *metacenter* (M). If the metacenter is higher than the center of gravity (2), the upward and downward thrusts act together to right the ship. But in a top-heavy ship (3), the metacenter may be lower than the center of gravity. Then the two thrusts act to capsize the ship.

Diesel Engines and Oil Fuel

Diesel engines need no boilers, and the space thus saved can be used for cargo. Also, they are more economical of fuel and need no lengthy "warming up," as a steam engine does, before a voyage can start. By the end of the first World War in 1918, the Diesel engine was favored for all cargo vessels and for all but the largest and swiftest passenger ships.

The steam engine later regained some favor, when it was improved by the use of extremely high boiler pressures and oil fuel instead of coal. Before the change to oil, 140 men worked three or four days to coal a large liner for a voyage; after the change, seven men could fill the oil tanks in six hours. A few men tending oil burners replaced 150 firemen shoveling coal. Space rated at 1,000 tons was freed for cargo. Navies use oil fuel whenever possible, both for economy and space saving and because vessels can refuel at sea from tank ships (*see* Navy).

Economy in fuel is of great importance, because the fuel bill may run from one-fifth to one-third of the entire cost of a voyage. The quantity of fuel burned mounts rapidly as speed increases. One vessel may burn 260 tons of fuel a day for a speed of 16½ knots; another not half so large may burn 316 tons to make 19 knots.

The Ancient Art of Shipbuilding

From early ancient times to our own day, the shipbuilder has always had to solve a three-part problem. His ship must have buoyancy enough to support its load. It must be seaworthy. It must have speed enough to do its proper work, whether in carrying passengers as rapidly as possible, in carrying cargo at a reasonable pace, or in meeting the complex demands of naval warfare.

Almost until the time of the American Revolution, these problems were worked out by "cut-and-try" methods. Designers followed successful older models closely and were timid about making changes. The American colonists learned this kind of shipbuilding from the English; but they proved more daring than their teachers. By the time the United States became a nation, some of the world's best vessels were the product of American shipbuilding.

The work was altogether a local industry in shipbuilding towns. The boys who loitered in the shipyards after school, watching a ship grow under the skilful hands of their friends and neighbors, expected themselves to build such ships or sail in them. Many of the workmen were old sailors. The owner's daughter might pose as a model for the figurehead shaped by the woodcutter in the corner of the yard. Most of the workmen were artists in their way, taking pride in the work of their hands and competing jealously for the more difficult tasks. Until about 1830 any skilled shipyard mechanic performed any and all work involved in the construction of a ship. Thus the industry was itself a school for all engaged in it, and continually built up designing and building skill.

Modern Scientific Shipbuilding

During this time, the swift advance in scientific knowledge was helping shipbuilders to escape from "cut-and-try" methods. An example of this new knowledge is given in the accompanying diagram, which shows how designers work out the problem of stability—that is, how to build a ship that will return to the upright position when it has been heeled over by high winds or rough seas. The change to scientific methods became complete with the use of steel and steam or motor power. The effect of this change can be seen by visiting any modern shipyard.

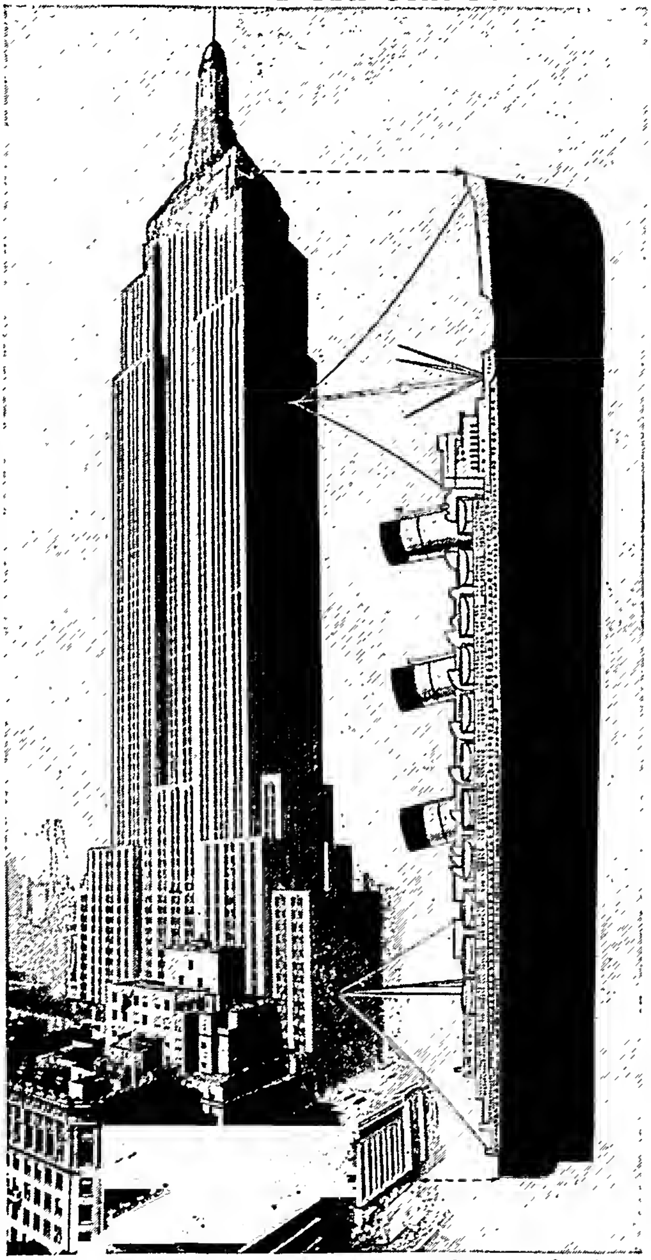
As we approach, our ears are assailed by a terrific clamor of crashing metal, from which presently we are able to pick out individual notes—roaring foundries, clanging engines, whirring dynamos, and thundering *pneumatic hammers*. At the water's edge, the cranes and scaffolding of the ways form a rough pattern of colossal steel lacework. Underfoot, instead of the springy carpet of spicy chips and shavings covering the ground in the wooden shipyard, we find a strange litter of heavy metal parts—steel plates and bars,

iron chains, etc. As various and, to many of us, as unfamiliar are the tasks of many of the men we see at work in the open air or in the vast interiors of the sheds and mills—furnacemen, rollers and flangers, punchers, shearers, acetylene cutters, electric welders, machine riveters, chippers, calkers, yard riggers, besides clerks, draftsmen, electricians, carpenters, machinists, painters, and unskilled laborers, employed on various specialized tasks. When the whistle blows and the 5,000 and more employees of the yard surge forth for the mid-day meal, we see as motley a mingling of races and nationalities—not only Americans, Englishmen, and Irishmen, but Scandinavians, Greeks, Portuguese, Italians, Slavs, and Negroes. Most of them know as little about the ships on which they are engaged today as they did about the bridges, the sky-scrapers, or the roads on which they were employed a few days or weeks ago.

In normal times, such data as tonnage requirements, speed desired, and depth of water in the harbors which the ship is intended to frequent are given to the designer of the ship to be constructed. He first calculates the displacement and then determines length, beam, and depth. From this start he works out his design. This method is modified when ships are needed in huge numbers, as in wartime. In such emergencies, shipbuilders turn to the methods of mass production to save time. Instead of drawing plans for each individual ship, marine architects standardize their designs for the various types of vessels. Thus a number of ships of the same type are built from a single design. The same standardized plans may be used by several shipyards.

The drawings or blue prints of the design, made to scale, are re-drawn full size on the floor of the mold loft. This room (usually the top floor of the largest building in the yard and 100 feet wide and several hundred feet long—large enough to take in the full-size plan of a liner or battleship) has a specially prepared floor, as smooth as a school blackboard. From the drawings on the mold-loft floor, full-size wooden or paper patterns, called "templates," are constructed for each piece of steel to enter into the vessel. On each template every rivet hole, bend, flange, or angle line is accurately indicated. The ship fitter transfers these marks to the steel plate, which is then taken to the steel mill to be cut, bent, punched, and shaped in accordance with the indications of the template.

LAND AND SEA GIANTS

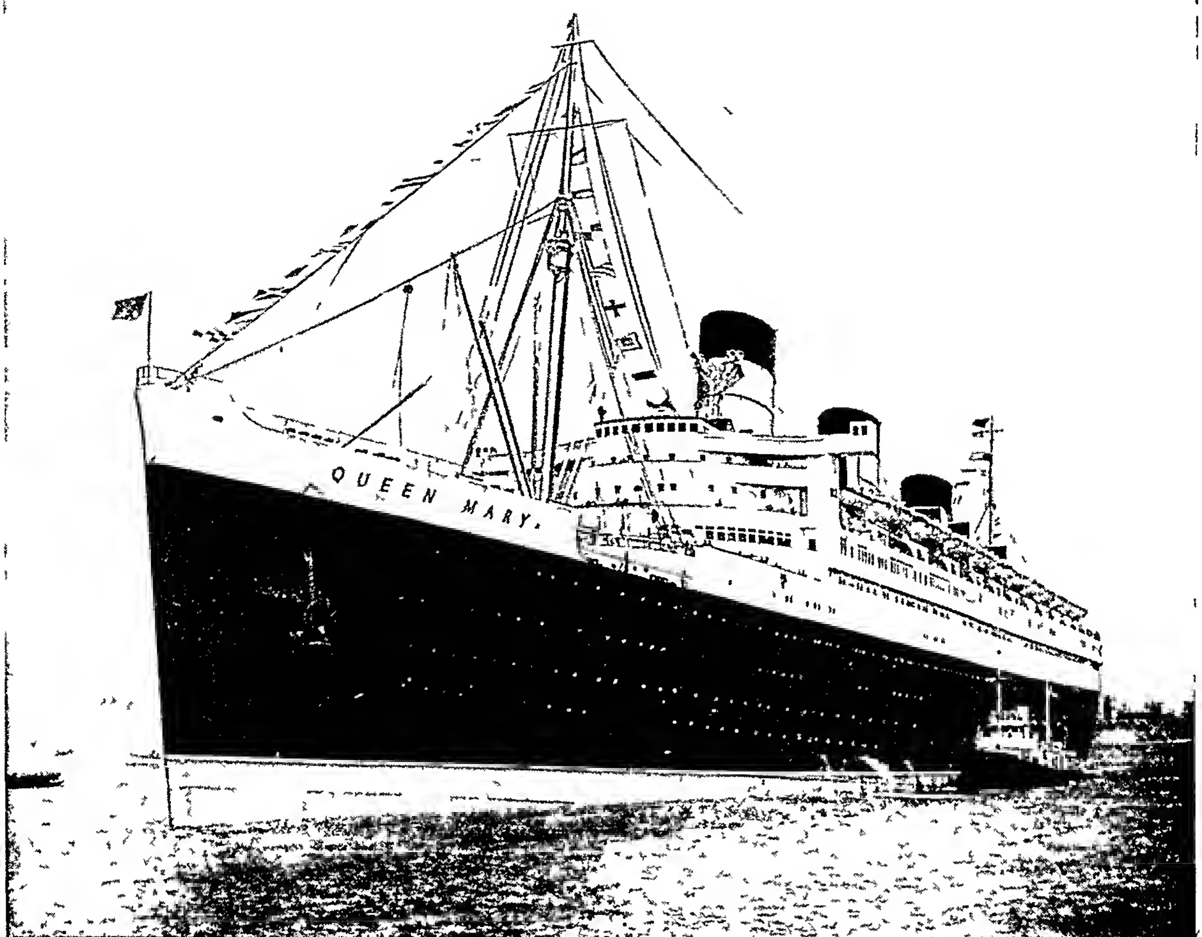


Here we see how a giant modern liner, more than 1,000 feet long, would look if stood on end alongside the Empire State building. This building is the only man-made land structure which rises higher than the length of the greatest ships.

Even this work is reduced greatly in wartime by building fabricated ships, as the United States did in 1918 and again in the second World War, especially freighters and tankers. To speed production, the standardized designs were made rigorously simple. Then steelmakers produced the simplified parts in quantity. In some instances, huge steel plates for the sides of ships were made at factories hundreds of miles inland. Such fabricated parts were sent to shipyards throughout the country, where workers assembled them into vessels. This use of fabricated parts largely cut the time of building a freighter from several months to a few weeks. The fabricated ship, in fact, was a "ready-made" as contrasted with a "made-to-order" ship, and this enabled the United States to build an unprecedented tonnage of vessels, both for the first World War and again when emergency need arose in 1940.

The actual construction of the ship begins with the laying of the keel. First, the berth for the ship is prepared at the water's edge. Keel blocks—short heavy timbers with the upper surface shaped to the

A HUGE AND SWIFT MODERN LINER



The *Queen Mary*, completed in 1936, was designed to make speed enough so that, with a sister ship operating on alternate runs, the Cunard Line could offer a weekly passenger service of the fastest class between Europe and America.

keel line—are set up with a very slight incline toward the water. On this is laid the keel, composed of a number of bars or thick plates of heavy steel, each perhaps 40 or 50 feet long, riveted together to make the desired length and thickness. While the frames are being built up from the keel and the plates are being riveted in place, temporary staging is erected inside and outside the hull as needed.

The steel plates which form the shell of the ship are laid, like giant fish scales, 20 to 40 feet long, in overlapping horizontal rows called "strakes." They provide the main strength of the hull, being merely supplemented by the frames. The seams of wooden ships are calked with oakum and pitch; steel ships are calked by driving down the overlapping edges of the upper plates so that they "bite" the plates below. In some of the latest vessels they are electrically welded instead of riveted, producing practically a solid metal shell.

Large steamships are built today with double bottoms, which lessen danger in case of accident. The space between the bottoms, in which a man can almost stand upright at the center of the hull, is used for ballast or for storing fresh water for the boilers or oil for the engines. Still more important for safety are the bulkheads or crosswise and lengthwise vertical partitions which divide the hull into watertight compartments. The more numerous these compartments, provided they are really watertight, the less the danger of sinking. The main lengthwise bulkhead is of special value also in counteracting the tendency of the ship to sag in the middle or to "hog," as drooping at the ends is called. Of particular importance is the "collision bulkhead" in the bow, which is built especially strong to withstand ramming and to confine the damage to that part of the ship if the bow should be stove in. The doors in the bulkheads are watertight and provided with closing apparatus electrically controlled from several central stations, so that any or all can be closed in a second by pushing a button.

The hull is usually launched as soon as it will float; construction and fitting are finished in the water. The launching must be as carefully planned as

the building, because ships have been wrecked by mishaps in launching.

Building Ships for Different Tasks

Vessels are given special designs to suit their work. Warships have always been in a class by themselves (*see* Navy). Most merchant ships are passenger or cargo vessels. The most important types are described in the accompanying table.

The cargo vessels used on the Great Lakes are shaped like long boxes, with flat sides and bottoms, except at the bow and at the stern. Opening the hatches on the long deck lays bare the entire hold. Gravity chutes can fill this space with 12,000 tons of ore in two hours, and huge clamshell grabs can remove the load in eight or ten hours (*see* Great Lakes).

Many cargo ships have refrigerated holds, kept cold by brine circulating in pipes, for carrying meat, vegetables, and fruit. On shallow rivers and some lakes, paddle wheels are used instead of screw propellers. The "whaleback" type of vessel has a cigar-shaped hull which allows waves to sweep over without doing damage.

The *ferryboat* is a special type of vessel. It has one or two broad decks to accommodate heavy loads of passengers and motor vehicles. Often both the nose and the stern are squared off, to fit snugly into landing slips. Car ferries have tracks on the lower deck to carry freight or passenger cars (*see* Railroads).

FACTS ABOUT MODERN SHIPS

Types of Modern Steamships

Express Liners ("Ocean Greyhounds")—The largest, fastest type of ship; speed, 25 knots or better; gross tonnage from about 25,000 up; luxurious passenger quarters with accommodations divided into *first class*, *cabin*, and *tourist*. These express liners have practically no cargo space.

Combination Ships—Passenger accommodations similar to those on express liners, but ample space for cargo. Wide range of sizes; speeds from 15 knots upward. The United States Maritime Commission's C-3 type of combination vessel accommodates from 60 to 96 passengers, and carries about 10,000 tons, or about 680,000 cubic feet, of cargo at a speed of 16½ knots.

Cargo Ships (Modern Types)—From 5,000 gross tons upward; speeds from 12 knots upward. The Maritime Commission's C-1 type has a cargo capacity of 7,786 tons, or 450,000 cubic feet, and makes 14 knots. The C-2 type is intermediate between the C-1 and the C-3.

Tankers—Similar to cargo ships, except that cargo space is fitted with tanks and necessary equipment for carrying petroleum or other liquids in bulk.

Largest Ships

Queen Elizabeth—British, about 85,000 gross tons; overall length, 1,030 feet; beam, 118 feet. First voyage (wartime), March 1940.

Queen Mary—British, 81,235 gross tons; overall length, 1,018 feet; beam, 118½ feet; 200,000 horsepower. First voyage, 1936.

United States—American, 53,000 gross tons; length, 990 feet; beam, 101 feet. First voyage, 1952. Speed, over 35 knots (exact speed, security secret).

Speed Record (Passenger Ships)

Set by *United States*, 1952; westward, 2,907 nautical miles, Bishop's Rock to Ambrose Lightship, 3 days, 12 hours, 12 minutes; speed, 34.51 knots; eastward, 2,938 miles, 3 days, 10 hours, 40 minutes; 35.59 knots.

The Men Who Work the World's Ships

When a ship puts to sea from any civilized land, it carries a highly organized crew commanded by *licensed officers*. The officers include the captain, or master, and his assistants (called either mates or officers), the chief engineer, and the assistant engineers. Each of these men must have a license, acquired by passing an examination by the government or other authority, after a certain length of service in lower grades.

Under the officers come two classes of men. The deck force consists of able-bodied seamen (A.B.'s) and apprentices. The able-bodied seamen hold certificates and do the more responsible work, such as keeping lookout, tending helm, and making difficult repairs. The engine room force under the engineers consists of oilers, who help tend the engines, and firemen. A cargo vessel's crew is completed by a radio operator, a steward, one or more cooks, and perhaps a mess boy. A passenger vessel carries the same kinds of workers but in much larger numbers, especially stewards.

A ship's crew is divided into groups called watches. Formerly all ships had two watches. While one watch operated the ship, the other rested. The watches changed at midnight and every four hours thereafter until 4:00 P.M. Then came two "dog watches" of two hours each. Thus the watches traded hours of duty for the following 24 hours and each watch had its fair share of the more pleasant hours. In emergencies or for heavy tasks, of course, the order "All hands!" summoned the entire crew. All American ships except the smallest types were required by the Merchant Marine Act of 1936 to carry officers and men enough for three watches. Each watch serves two turns of four hours each.

Safety at Sea

The principal law regulating safety at sea is an international convention accepted by the United States and proclaimed in effect on Nov. 7, 1936.

This law requires certain safety features, such as bulkheads and a double hull, which vary with the size of the vessel and the number of passengers carried. Ships must always have a certain freeboard; that is, the sides must stand a certain height above water; the amount varies with the season and in different oceans. Many ships show the required freeboard with a *Plimsoll mark* on the side.

A life preserver and lifeboat accommodation must be provided for every person on board, except on ferryboats and excursion steamers making short trips. These may carry rafts instead of lifeboats for part of the passengers. Rigid standards govern the stowage of gasoline and other explosive and inflammable materials. Vessels are inspected periodically to make sure they comply with these requirements. Ships' crews drill frequently in such safety measures as fighting fire, closing watertight doors, and launching life boats. Harbors provide other aids, as buoys, lights, and

channel markers, as well as pilots, tugs, and fire-fighting boats (*see* Harbors and Ports; Navigation).

Rules of the Road

Ships everywhere must obey strict "traffic laws" devised to prevent collisions. On the high seas these are the 'International Rules of the Road', established by agreement among maritime nations. For coastal waters of the United States the 'Inland Pilot Rules' apply. These laws (usually called the "Inland Rules") were enacted by Congress. On the Great Lakes, the Red River of the North, and rivers emptying into the Gulf of Mexico, ship captains must follow special pilot rules for these bodies of water. In many harbors, also, local rules apply.

In all essentials the International and Inland Rules agree. The Inland Rules merely supplement the others. Both provide that when the paths of two ships are about to cross, the ship having the other on its starboard (right) side must keep clear. The other ship must continue at the same course and speed until danger of collision is past. When a steamship meets a sailing vessel, the steamship must always keep clear.

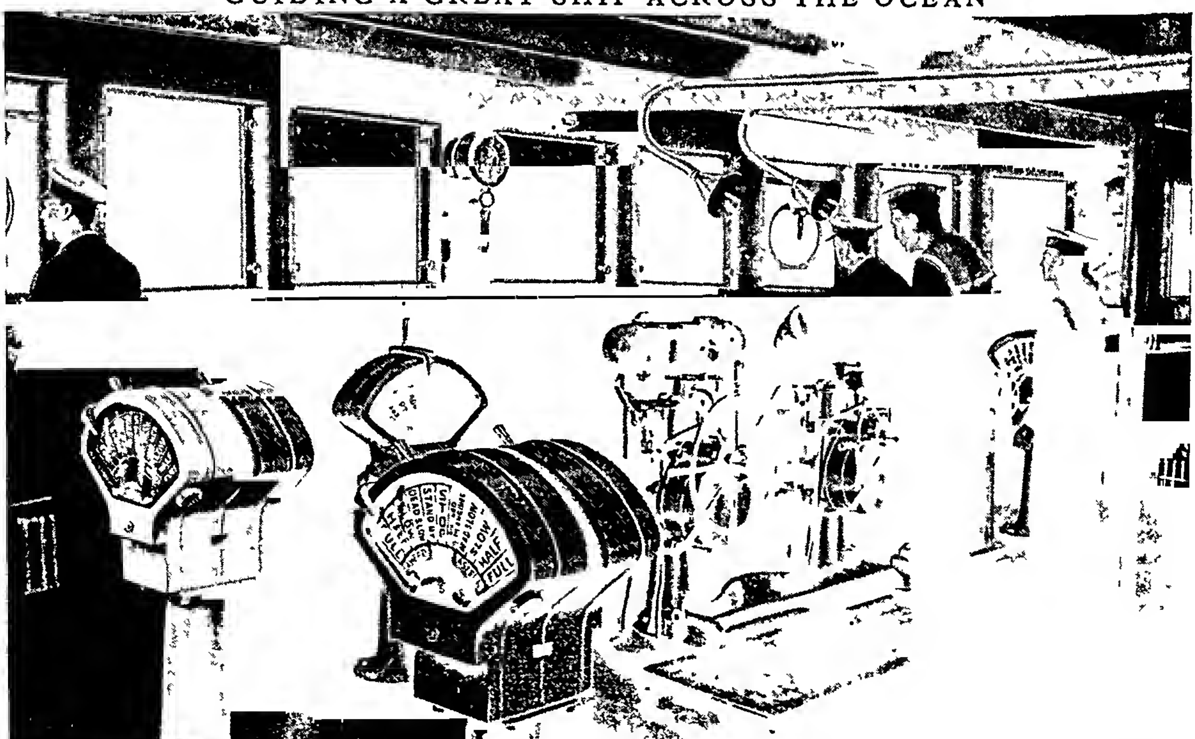
Inland Rules provide that when two ships are about to meet head on, each must turn to starboard. Each vessel blows one short blast on the whistle, signaling intention to turn. If the ships will pass clear of each other they do not need to change course. But if they will pass with each on the starboard side of the other, each ship signals with two short blasts on the whistle. A steamship backing down in sight of another must give three short blasts on the whistle. Four or more short blasts indicate that one ship does not understand the intentions of another. A single long blast is used by ships backing out of their berths or approaching a blind turn in a channel.

Underway, all ships must carry a red light on the port side and a green light on the starboard side. Steamships also carry a white light on the foremast or fore part of the ship. They may also carry a second white light above and behind the first. At night these *running lights* permit other ships to make out what direction a vessel is going. Special lights must be shown when a ship tows a disabled vessel, a string of barges, a cable, or a fish net or trawl.

At anchor, ships more than 150 feet long must display one white light near the bow and another near the stern (*anchor lights*). Shorter vessels show only the bow light.

In a fog, mist, falling snow, or heavy rainfall, ships must navigate with caution and must signal constantly with a steam whistle, foghorn, or bell. These sound signals vary for ships in different waters. On the high seas ships must blow one prolonged blast every two minutes. A ship "lying to"—that is, stopped but not at anchor—must sound two prolonged blasts every

GUIDING A GREAT SHIP ACROSS THE OCEAN



Here we get a glimpse inside the pilot house of a great liner at sea. The helmsman, who on a big ship is a rated quartermaster, stands at the wheel with an emergency wheel at his left. Directly in front of him is a gyrocompass repeater. The large object with iron spheres on either side is the magnetic compass. To the helmsman's right is a relief helmsman, and in front of this man is the gyropilot control box. Beyond the helmsman stands the senior watch officer. He is looking through the "clear-vision window"—a whirling disk of glass which throws off snow or rain. At the extreme left stands the junior watch officer. In the immediate foreground are two telegraphs to signal the engine room, and beyond them a telegraph to the emergency steering room in the stern of the ship. Hanging from the ceiling are speaking tubes for communicating with the officers on the bridge and in the engine room. On the forward wall (or bulkhead) is an instrument which indicates engine speed.

two minutes. A ship towing another vessel or cable or unable to get out of the way of another vessel must sound at two-minute intervals one prolonged blast followed by two short ones. At anchor, ships must ring a bell for about five seconds each minute.

Shipping Costs and Services

Ships give the cheapest form of transportation. Low shipping rates enable nations to buy wherever goods can be manufactured at low cost and to produce those goods which they can make cheaply. The United States, for example, can exchange its foodstuffs, manufactures, and metals for rubber, tea, coffee, and silk. (*See* Trade; International Trade.)

There are three kinds of shipping service. Some companies operate their own ships. Much of the world's petroleum is carried in company-owned tankers. For general passenger and cargo service, shipping companies operate liners on regular schedules. Tramp ships take on and discharge cargo at almost any port. They have no regular run or schedule.

The American Merchant Marine

American shipbuilding began in 1607 when members of a projected colony on Kennebec River in Maine built the *Virginia*, a 30-ton pinnace, and sailed in it to England rather than face a Maine winter. Commercial shipbuilding and seafaring began in 1631 when the colonists of Massachusetts Bay launched the 30-ton *Blessing of the Bay*. Thereafter these activities grew rapidly in New England (*see* American Colonies).

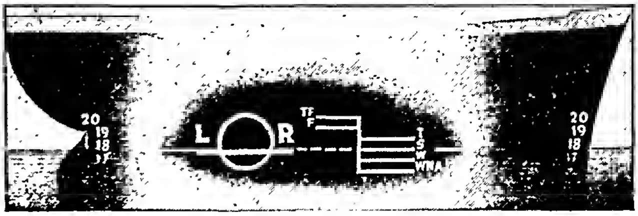
After the Revolution, American seamen built up a world trade. Their greatest achievements were in trade with the Orient. Boston ships developed a trade route around Cape Horn to the northwest Pacific coast of North America to obtain furs, and thence to China, where they traded furs for tea and silk. The first of these voyages was made by the *Columbia* of Boston in 1778–89. Before this, in 1784–85, the *Empress of China* of New York City had sailed around the world.

In 1816 United States ships entered the packet service between New York City and Liverpool, carrying passengers, mail, and express on fast, regular voyages. American seafaring reached its greatest success in the clipper-ship days of the 1850's. Thereafter the American flag almost disappeared from the high seas, because the United States could not build and operate steamships as cheaply as European nations.

A serious lack of merchant ships led the government to set up the Maritime Commission in 1936. It was authorized to train crews and regulate working conditions, to lend money for shipbuilding, and to subsidize the building and operating of American ships. In 1950 the Federal Maritime Board and the Maritime Administration of the Department of Commerce took over the functions of the commission.

When World War II broke out in 1939 there were about 58 million gross tons in the world's merchant fleets. The British Empire owned nearly one third of this total; the United States, 14 per cent; Japan, Norway, and Germany, between 7 and 9 per cent each; Italy, France, Netherlands, Greece, Sweden, Russia, and Denmark, between 2 and 5 per cent each.

THIS MARK PREVENTS OVERLOADING



LR	Lloyd's Register of Shipping
TF	Tropical Fresh Water
F	Other Fresh Water
T	Tropical Seas
S and W	Other Seas, Summer and Winter
WNA	Winter in North Atlantic

A Plimsoll mark is painted on both sides of a ship to show the load permitted by law. The small letters indicate the safe water line for different regions. The numbers at the bow and stern tell how deep a ship is in water. Here its draft is 18 feet.

Great losses were suffered in World War II. During the war, the United States built a tremendous number of ships. After the war, many nations constructed numerous ships. By 1953, the world's merchant vessels totaled about 82 million gross tons. The United States is now first with nearly one third of the total. The British Empire owns 11 per cent, and Norway 7 per cent. Panama, France, Italy, Netherlands, Japan, Sweden, Russia, and Denmark each have between 2 and 5 per cent.

Laws Governing Crews

United States law requires that 90 per cent of the crew on all American vessels except the smallest be American citizens. Aliens are permitted only as stewards on passenger ships. The La Follette Seamen's Act of 1915 and later laws ended many abuses, such as imprisonment for desertion and corporal punishment. They required adequate food, medical attention, and sanitation for crews.

How Ships Are Measured

A ship's size and capacity are expressed in various terms. *Displacement* or *displacement tonnage* is the weight of the water which the ship displaces—in other words, the weight of the ship itself.

Dead weight tonnage is a ship's maximum carrying capacity, or the difference between its displacement when light and when loaded to its limit. Passenger and freight liners are seldom loaded to capacity, and the term is not used for them but chiefly for charges on tramp ships chartered to carry heavy commodities.

Gross tonnage is a ship's available space in "tons" of 100 cubic feet each. Certain spaces are not measured. The official United States mercantile marine statistics are estimated in gross tonnage.

Net tonnage is what remains of gross tonnage after deduction of space for fuel, machinery, crew's and officers' quarters, and other areas necessary for operation of the vessel. It is sometimes estimated that net tonnage averages about two thirds of gross tonnage, but the ratio varies widely in vessels. Net tonnage may be insignificant in an ocean greyhound. The basis for tonnage dues is net tonnage, which is calculated according to arbitrary rules.

FOOTWEAR
Through the Ages

SHOES. From simple protection of the foot to one of the most varied fashion items—that is the fascinating story of the shoe. And more—it has played a part in social customs and folklore. Even today we tie old shoes to the newlyweds' automobile for "good luck." We speak of the "shoe on the other foot" and "dying with his boots on." The Bible often mentions the shoe, and children have grown up with the wonderful tales of Cinderella and Puss in Boots.

Shoes Begin with Early Man

Man is the "tenderfoot" among animals. Nature does not protect his feet from burning sands and stony ground with soft cushions like those of the cat or with horny hoofs like those of the horse.

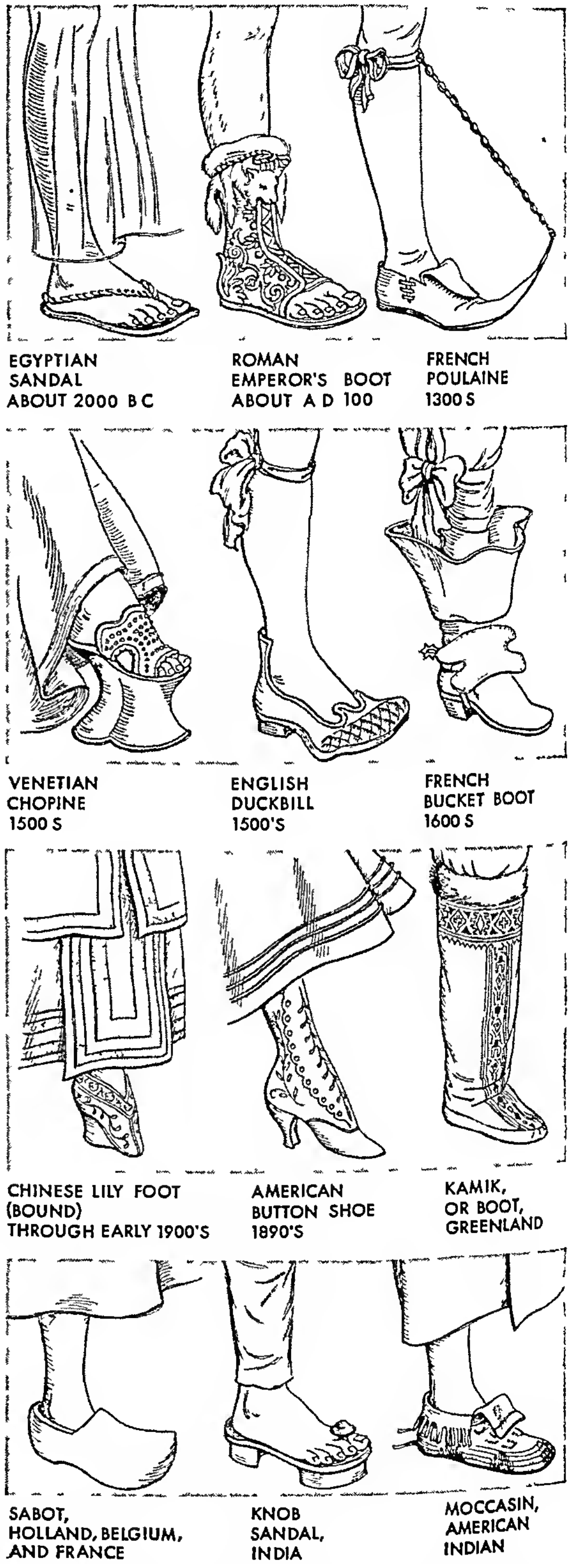
In very ancient times, man covered his feet with the closest available materials—bark, woven grass, leaves, or animal skins. He held these crude coverings to his feet with thongs. From these primitive beginnings developed the three standard kinds of footwear—the sandal, shoe, and boot.

Still preserved today are Egyptian sandals made about 2000 B.C. from plaited papyrus leaves (*see* Egypt, Ancient). The ancient Greek craftsmen created artistic sandals and the Romans considered their extravagant footgear to be badges of rank (*see* Greece; Roman History). With their heavy hobnailed sandals, Roman soldiers marched roughshod over weaker peoples.

Whereas the Egyptians, Greeks, and Romans displayed the body, the Christians of the early Middle Ages concealed it. Their clumsy shoes hid the foot. In the 11th century the Crusades began, and contact with the Orient influenced a change in style to more flowing and decorative lines (*see* Crusades). During this medieval period shoemakers, like other craftsmen, formed guilds to promote quality work (*see* Guilds).

Edward II originated shoe sizes in 1324. He decreed that three barley corns, placed end to end, equaled one inch. The longest normal foot measured 39 barley corns, or 13 inches, and was called size 13. Smaller sizes were graded down from this number, each by a third of an inch.

During the Renaissance, shoe fashions ran to ridiculous extremes. The higher the rank of the wearer, the longer were the toes. The French called these long shoes "poulaines" after Poland, and the English, "crakows" after Cracow, then capital of Poland. Some dandies wore shoes two and one half feet from heel to toe and held up the toes by tying them to the knees



These illustrations trace the development of footwear in many lands from ancient Egyptian times to the present. They show that foot protection, warfare, vanity, and custom have influenced the design of shoes and boots. Even today unusual footgear is worn. Some kinds are shown in the last few pictures. The historical shoes pictured above are described in the article.

with chains. Then the duckbill came into fashion. Its ever-wider toe attained a width of nine inches. Laws put an end to these ludicrous styles. Later vain Venetian ladies adopted the high Oriental clogs, or chopines. These were shoes on top of stiltlike blocks of wood, some a foot and a half high.

Prominent in men's dress in later centuries were boots. Some were so tight fitting that to put them on a courtier had to soak his legs in cold water to shrink their size. Others had such wide tops that they were called bucket boots.

It was about the time of the Civil War that the manufacture of right and left shoes first became generally accepted. Unusual in the 1890's was the high-buttoned shoe with toothpick toe. Early in the 20th century China made it a penal offense to bind girls' feet, as had been done for centuries (*see* China).

Shoe Fashions of Today

Many people still wear styles that have not changed for generations. These include the knob sandals of India and the moccasin of the American Indian. Eskimos and other people living in cold climates wear soft-skin boots. Still in use is the wooden shoe, or sabot, worn by peasants of Europe (*see* Netherlands).

In the United States of the present century, the variety and quantity of shoes have increased greatly. Most shoe fashions are variations of 16 basic styles—the balmoral, blucher, boot, brogue, d'orsay, gillie, gore, jodhpur, moccasin, monk, mule, oxford, pump, sandal, shawl tongue (or kiltie), and strap.

Sportsmen and workmen wear special shoes. Bowlers, skiers, skaters, and other athletes have specially designed shoes. Hazardous occupations require safety shoes with reinforced toe caps of steel, fiber, or plastic. Much study has been given foot comfort, especially for army shoes. They must be correctly built so as not to cramp or blister the feet.

Growth of the Great Shoe Industry

In America shoemaking as a craft began in 1629 when Thomas Beard, a shoemaker, arrived from London. He settled in Salem, Mass., to make shoes under contract for the Massachusetts Bay Colony. Early colonists tanned leather and made their own shoes (*see* Leather). Later, itinerant cobblers went from town to town. They made crude shoes with silver buckles. These shoes could be worn on either foot.

Then shoemakers set up shops in villages. They passed on their trade through apprentices. A master shoemaker taught a boy how to make shoes in return for his help. The first to operate a shoe shop on the factory system was John Adam Dagyr, a Welshman who came to Lynn, Mass., in 1750. He had each workman do a single operation in making a shoe. He is called the "father of American shoemaking." About 1800 came the Ten Foot shops. They were named for their small size and usually had four workmen.

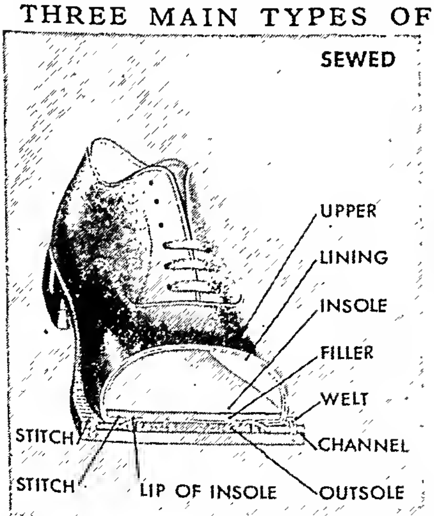
Until the middle of the 19th century work on shoes was done by hand. Then ingenious American inventors developed machines. The first was the rolling machine, invented in 1845 to replace the lapstone and beating hammers for making leather stronger.

In the same year Elias Howe invented the sewing machine. It was used for stitching upper parts of shoes (*see* Howe; Sewing Machine). John B. Nicholas improved the machine. In 1858 Lyman R. Blake patented a machine for sewing together soles and uppers. This was a great advance over the use of pegs, nails, or hand sewing. Gordon McKay made improvements on Blake's machine. About 1874 the welt stitcher of Charles Goodyear, Jr., made possible machine production of welt shoes, a high grade type.

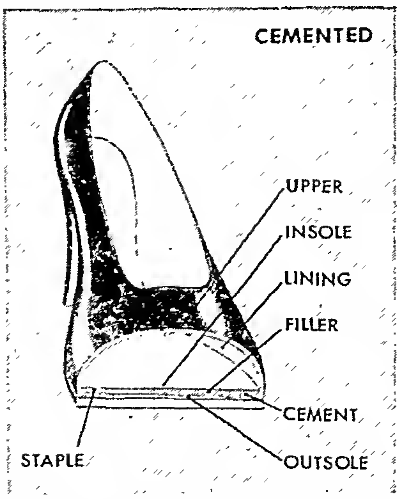
In 1896 Humphrey O'Sullivan, a printer in Lowell, Mass., patented his invention of the rubber heel. He stood on a rubber mat to ease his tired feet as he set type. It was inconvenient to carry the mat, so he nailed pieces of it to his heels. To keep the nails from working loose, he molded washers into the rubber.

An important development in the shoe industry was the formation of the United Shoe Machinery Corporation in 1899. It combined several leading shoe

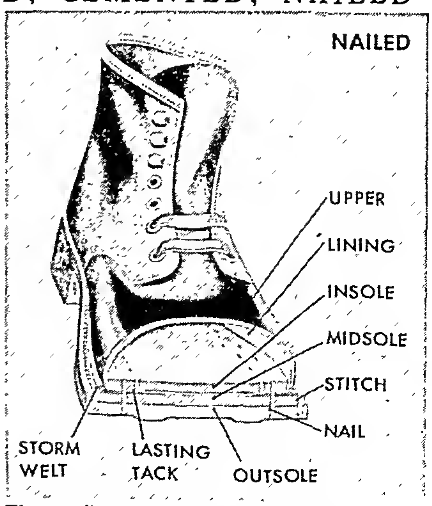
THREE MAIN TYPES OF CONSTRUCTION—SEWED, CEMENTED, NAILED



In the Goodyear welt construction, both the upper parts and the outsole are sewed to a narrow strip of leather, or welt.

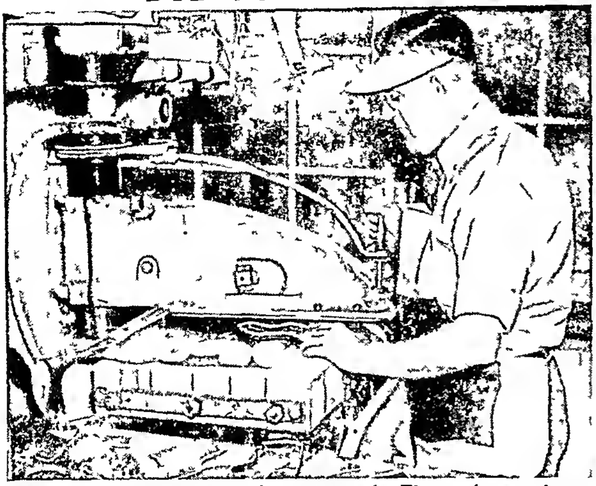


Pyroxylin, synthetic resin cement, latex, or some other adhesive binds the outsole to the upper parts in the cemented shoe.

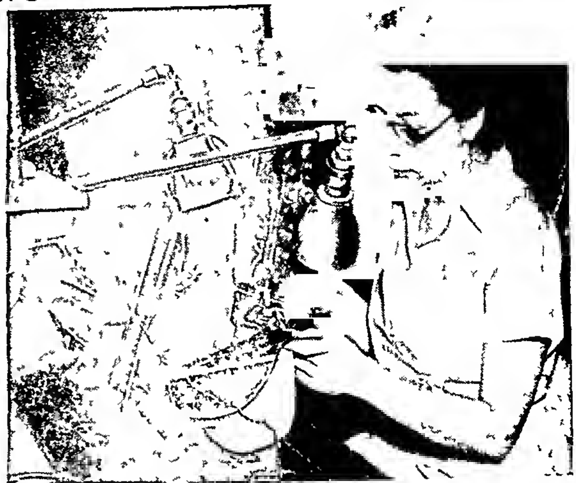


The nailed process is widely used for durable men's work shoes. Nails sturdily hold the outsole to the rest of the shoe.

DIE CUTTING AND SEWING THE UPPER LEATHER



These two pages show how shoes are made. The workman above is cutting the upper, or top part of the shoe, from a piece of leather with a steel die and the hydraulic arm of the machine.



The shoe takes shape as an operator stitches the parts of the upper and lining. Other workers have finished the raw edges of the leather, inserted eyelets, and perforated designs.

machinery companies, each making machines for a principal operation, thereby reducing patent litigation and improving the service of shoe machinery. The Compo Shoe Machinery Corporation was organized in 1928 to make machines for attaching soles with cement. This process was about 70 years old at the time, but machine production made its use widespread.

Until early in the 1940's, almost all machines in shoe factories were leased rather than owned. This system began when early shoe manufacturers did not want to incur heavy investments by buying McKay's machinery. McKay then persuaded them to rent his machines, and this practice largely prevails. The fees amount to large sums of the total annual value of production but represent about one per cent of the price of a pair of shoes. In recent years, shoe manufacturers have been purchasing rather than renting machinery.

How Shoes Are Made

More than 200 operations are sometimes performed in making a pair of shoes, about 150 of these by machine. With machine production, a pair of shoes can be made in less than one man-hour. With hand labor, the output was less than one pair per man in a day.

In manufacturing, shoes are classified according to the way soles are fastened to uppers—sewed, cemented, and nailed. About one third of all shoes are of sewed-welt construction. Most women's shoes are made by the cement method. The sewed and nailed processes have largely taken the place of wood pegging and screw wiring in men's work shoes.

Most shoe factories have eight general departments. The *upper-cutting department* prepares uppers, consisting of vamps, tips, quarters, backstays, tongues, and linings. These may be cut from hides and skins of cattle, calves, goats, sheep, and horses. Skins of kangaroos, pigs, and sharks are also used. Some uppers, especially for women's shoes, are cut from reptile skins, such as snake, lizard, and alligator; from linen, satin, and other fabrics; or from plastics, including nylon. Patent leather is leather coated with varnishes or enamels. Upper cutting is done by machine or by hand. Hand cutting with a knife and metal-bound cardboard patterns is used for producing shoes of fine leather, of fancy design, or in small lots.

In the *upper-fitting department* keen-bladed skiving machines bevel or shave raw edges of leather so that they can be turned over and cemented. Long lines of sewing machines stitch uppers to linings. Other machines punch decorative designs and insert eyelets.

The *stock-fitting department* produces bottom stock—outsoles, insoles, welting, box toes, counters, and heels. The outsoles may be made of leather, crepe rubber, rubber, composition, fiber, neolite, or other materials. Box toes and leather or fiber counters, placed between the upper and lining at the heels, protect the feet and preserve the shape of the shoes. Heels may be made of leather, rubber, composition, or wood.

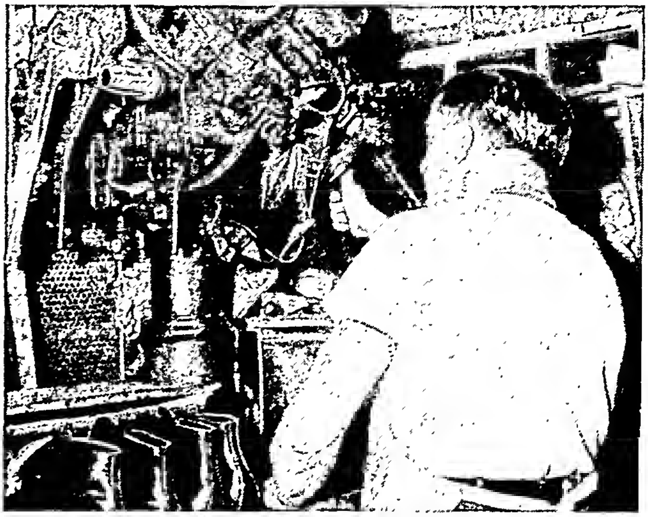
In the *lasting department* uppers, box toes, and insoles are assembled and put on lasts. The last is a wooden form, the shape of and somewhat larger than the foot that the shoe is designed to fit. Pulling-over and lasting machines draw the upper tightly over the last and fasten it to the insole.

In the *bottoming department* attaching soles to uppers is done in many different ways. In the Goodyear welt method, edges of the upper and lining are sewed to a rib on the insole and also to a welt, or narrow strip of leather. The outer sole is then stitched to the welt. Many manufacturers consider this construction to be the best process because no stitches appear on the inside to irritate the feet.

In the McKay shoe process the upper and lining are permanently clinched together with tacks to the inner sole, and then the upper, lining, insole, and outsole are sewed together. This shoe is generally less expensive and lighter than the welt type. It needs a sock lining to protect the foot from clinched tacks and stitches. The lightweight and expensive turn-process shoe has only an outsole, upper, and lining. It is so

CUTTING SOLE LEATHER AND PULLING UPPER OVER LAST

The powerful dinking machine cuts the heavy leather for the sole, or bottom, of a shoe. Its sharpened steel dies are heavier and thicker than those used for cutting upper leather.



The amazing fingers of this intricate pulling-over machine draw the upper and lining of the shoe tightly over the last, or wooden form shaped like a foot. The machine then tacks them in place.

named because its parts are sewed while they are inside out on the last and then turned right side out. In stitchdown-process shoes the upper and lining are turned outward and sewed to one, two, or three layers of sole leather. Many infants' shoes are made by this method. For cemented-process shoes, the welt, upper, or insole is coated with pyroxylin or some other cement, and the outsole is pressed on.

Popular for women's informal wear are slip-lasted, or California-process, shoes. The upper and a sock lining are sewed together and a platform cover is stitched to them. A hinged last is then slipped into the upper and a thick platform is pressed into place. The sole is cemented or sewed to the platform.

After shoes are bottomed, they go to the *making department* where machines attach heels. In the *finishing department* the bottoms are scoured, gummed, or waxed and the lasts are removed. Cleaning and dressing are done in the *treeing and packing department.* After the shoes are fitted with findings—bows, laces, and buckles—they are inspected and packed.

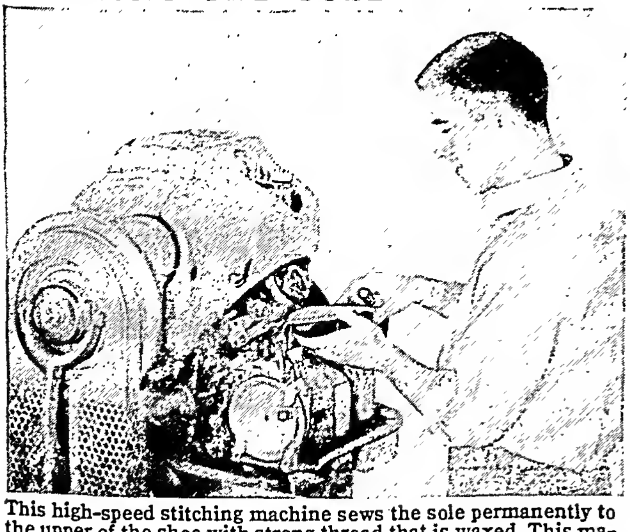
Leading Shoe-Producing Nations and States

The United States is the world's foremost producer and consumer of shoes. Its factories turn out about two fifths of the world shoe production of more than one billion pairs of shoes a year. Other leading producers are Great Britain, Russia, France, and Germany. Massachusetts was long the chief producing state, but now shares leadership with New York. Other large manufacturers are Missouri, Pennsylvania, New Hampshire, Maine, Illinois, and Ohio.

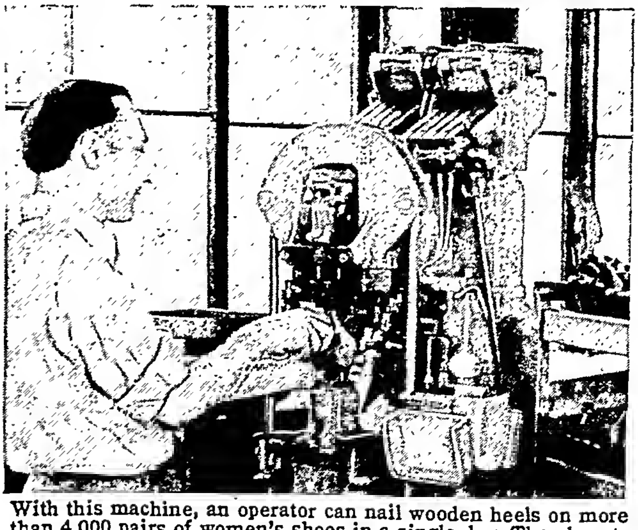
Shoe Selection and Care

Proper selection and care result in longer shoe life. Shoes should fit well so as not to damage the feet, which have one fourth of the bones of the body and many ligaments, muscles, nerves, and tendons (*see* Foot). Wet shoes should dry slowly—never on a radiator or stove because heat harms leather.

SEWING THE SOLE TO THE UPPER AND NAILING ON THE HEEL



This high-speed stitching machine sews the sole permanently to the upper of the shoe with strong thread that is waxed. This machine has more than 750 moving parts.



With this machine, an operator can nail wooden heels on more than 4,000 pairs of women's shoes in a single day. The almost-completed shoe is now ready for final finishing operations.

SHORTHAND. Shorthand, or *stenography* (short writing), is a method of writing with brief signs fast enough to take down speech. A very rapid writer of longhand (ordinary writing) can write only about 35 words a minute. Expert stenographers have made speed records of more than 250 words a minute on difficult technical matter. The average public speaker talks at a rate of about 120 to 150 words a minute. A businessman dictating a letter averages about 80 words. A stenographer just out of school can usually take dictation at this speed.

Systems of shorthand have been in use since very early times. In 63 B.C. the speeches of the Roman orator Cicero were taken down in shorthand by his secretary Tiro, a Greek slave. The Tironian system was used for centuries by the early Christian church. But shorthand writers were not in great demand until the late 1800's, when the typewriter came into general use (*see* Typewriter). Shorthand combined with typewriting gave businessmen an easy, speedy method for writing letters, and schools sprang up to train stenographers. The development of dictating machines (*see* Dictating Machine) has hardly lessened the demand for stenographers in business. Congresses and parliaments, the United Nations, courts of justice, and political and scientific conventions also offer careers for competent shorthand reporters.

Hardly a year passes without bringing out a new system of shorthand or some modification of an old one. Nevertheless in the English-speaking world practically all schools today teach either the Pitman or the Gregg system. Both systems originated in Great Britain. Isaac Pitman's great contribution to shorthand was the devising of an alphabet based on a scientific classification of language sounds. With the publication of his first book in 1837 ('Stenographic Sound Hand') shorthand became a practical skill. John Robert Gregg published his first book in 1888. He followed Pitman's system of language sounds but used a different written alphabet. A stenographer who has learned either system can use it to record any language. Gregg is taught today in a majority of the shorthand schools in the United States.

Speedwriting employs the familiar longhand alphabet. Words are shortened by using abbreviations to suggest various sound groups. Thus the letter N stands for "inter," and "You will be" is written U L B. Speedwriting is easier to learn than shorthand and can be written two or three times as fast as longhand.

Pitman Shorthand

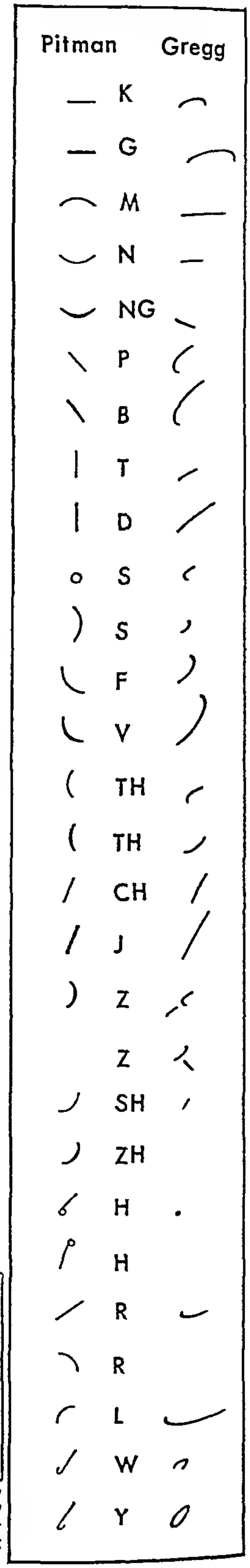
Pitman characters have simple geometric forms. The curves are parts of a true circle. Some letters are written with a light stroke, some with a heavy (shaded) stroke. The light and shaded strokes of the same form usually represent closely related sounds. Thus P is a light stroke and B, written with the same slant, is heavy. Some consonants can be written in more than one way. Thus for blended consonants, such as PL and TR, the L and R are indicated by hooks. Shortening a stroke by half adds T or D.

Single vowels are indicated by dots or dashes and diphthongs by small angles. These vowel signs are not written into the word outline but are placed close to the stroke. In rapid writing they are omitted except when needed for ease in reading an unusual word. The first vowel in a word, however, is always indicated by *position writing* — placing the stroke of the first consonant above, on, or through the line of writing. For this reason, Pitman should be written on ruled paper.

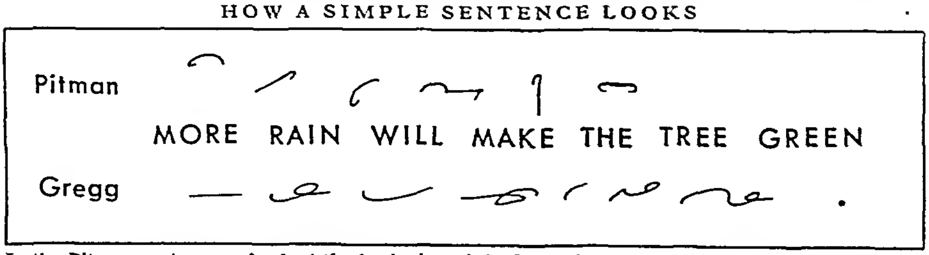
Gregg Shorthand

Gregg based the curved forms of his alphabet on the parts of an ellipse instead of the circle. This gives Gregg shorthand a flowing cursive form of writing like longhand.

SHORTHAND ALPHABETS



HOW A SIMPLE SENTENCE LOOKS



In the Pitman sentence, a hook at the beginning of the M outline adds R to make the word "more." For "rain" a hook at the end of the outline R adds the sound N. "Will" is a word sign (L). "The" also is a word sign—the little tick added to the word "make." The same hooks for R and N appear in "tree" and "green." In Gregg, M is a brief form for "more." In "rain" a large circle, representing A, is inserted between R and N. In "tree" and "green" the small circle represents E.

Gregg has no shaded outlines. It does not use position writing, and may therefore be legibly written on unruled paper.

Vowels are indicated by hooks or circles. Diphthongs are combinations of hooks and circles. The vowels are inserted into the word in their proper place without lifting the pencil. They are called "connective vowels."

Like Pitman, Gregg varies the length of strokes. For example, the Gregg sign for S becomes F when it is doubled in length, and V when it is tripled.

Abbreviated Forms in Pitman and Gregg

About 200 words constitute more than half the words used in ordinary spoken and written language. For these much-used words and for common phrases, shorthand uses abbreviations. These abbreviations are called "word signs" in Pitman and "short forms" or "brief forms" in Gregg. They are usually some part of the complete shorthand outline. Often several abbreviated forms (such as "it will be," "of course it is") are written as a single outline without lifting the pencil from the paper. Such an outline is called a *phrase*. To gain speed, the writer combines almost any words into a phrase. Abbreviated forms are used also for prefixes and suffixes, such as con, inter, tion (shun).

Shorthand Machines

With a shorthand machine, such as the Stenotype, Stenograph, or Brevitype, a competent operator can take continuous dictation at very high speed. The machines are used in offices as well as for reporting proceedings of courts and conventions.

A shorthand machine looks like a small typewriter. It prints letters, not shorthand outlines. The operator spells by sound, like the shorthand writer. Eight or ten keys may be struck at the same time, as on a piano, so that a complete short word or part of a long word can be written at one stroke. The keyboard of the machine is small (about 22 keys) and has no duplicate letters. Each letter appears on only one side of the keyboard. To write such a word as GIG, therefore, the operator uses an arbitrary combination of letters to represent the letter missing on one side of the board—for example, TK I G. The words are printed on a continuous narrow tape, which folds into a tray at the rear of the machine.

SHREVEPORT, LA. For about 70 years Shreveport was only a small cotton port on the Red River. Then oil was discovered in near-by Caddo Lake. (Authorities variously give the date of discovery as 1904, 1905, and 1906.) Rich oil and gas wells were developed in northwest Louisiana and adjacent regions of Texas and Oklahoma. Shreveport boomed as the headquarters of this rich strike. Commerce and industry sprang up, and Shreveport grew to be Louisiana's second largest city.

Excellent transportation facilities and the abundance of low-cost fuel provided the basis for a thriving manufacturing industry. More than 250 plants now make a wide variety of goods. The chief industries are petroleum refining and the manufacture of metal and lumber products. A large plate glass plant is also located here.

Shreveport's many redbud trees have given it the name "Redbud City of America." They are especially colorful in spring during the annual garden tour. The residential section has charming homes, beautiful churches, and spacious parks.

Centenary College, one of the oldest colleges west of the Mississippi, is located here. The city is also the site of the annual Louisiana State Fair. West of Shreveport is Cross Lake, which supplies the city's water, and is also a recreational area. East of the river is Barksdale Air Force Base.

Shreveport was founded in 1835 by Henry M. Shreve, an ingenious river captain. At that time he was commissioned by the United States government to open the Red River to navigation. For years a huge jam of driftwood had clogged the river. Some say the jam was 130 miles long; others say from 160 to 180 miles. Explorers called it the "Great Raft." Shreve used "snag boats" as battering rams and in six years cleared the river to Fort Towson, Okla.

The silt deposited by the river's backwash provided a rich soil for cotton growing. And with navigation open on the river, the little settlement of Shreve Town soon became an important cotton market. In 1839 it was incorporated as Shreveport.

Through the years the silting of the river's bottom and erosion of its banks caused a decline in water traffic. But construction has begun on a canal that will parallel the Red River to the Mississippi. Population (1950 census), 127,206.

SHREW. The smallest and most bloodthirsty of all mammals is the shrew. This is a tiny, mouselike creature, from three to six inches long. It has dense, velvety fur, a long, pointed snout, wedge-shaped skull, long tail, and tiny, beady eyes.

Shrews live throughout the Northern Hemisphere in dense, grassy fields, in marshes, and under the roots, leaves, and rotten logs of moist woodlands. Although they are abundant and widely distributed, people seldom see them. They are most active at night, and always under cover. Their small size and quick movements make them extremely hard to observe.

They feed chiefly on insects, worms, and snails. But they also eat other small animals, especially field mice. Shrews have teeth sharp as daggers, and they kill larger prey with swift bites. They are also cannibals. If two shrews are put in a cage for a few hours without food, the stronger will eat the weaker.

There is a reason for their ferocious behavior. They must eat almost constantly to stay alive. They are so tense and active that their little bodies must change food swiftly into tissue and energy. If deprived of food for only a few hours, they die. They are food for many animals and birds. But some avoid them because their scent glands have a strong odor. Shrews are extremely sensitive to touch and changes of temperature, so they usually die when captured.

The female shrew makes a dainty little nest of leaves and grass beneath a log, rock, or other shelter. The incredibly tiny babies number 4 to 10. Three or four litters a year are born from spring to

fall. The adult's life span is only about 12 months. Apparently they die at the end of the first breeding year. Shrews do not migrate or hibernate, but remain active all winter. The voice is a high-pitched squeak.

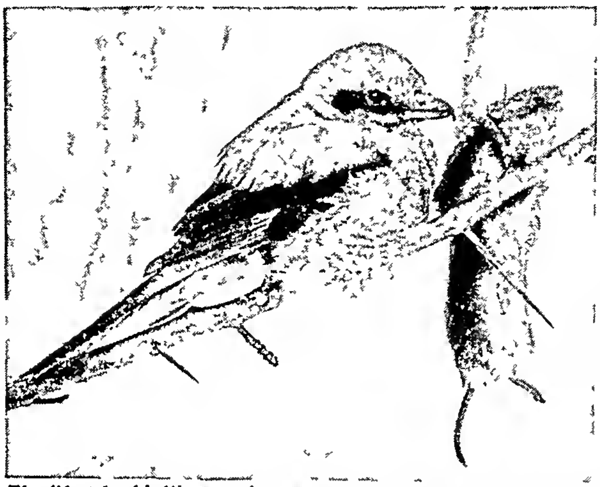
Shrews are closely related to moles, and like them belong to the order of insect eaters (*Insectivora*). They comprise the family *Soricidae*. The common long-tailed shrew (*Sorex cinereus*) ranges in North America from the Arctic Circle to Mexico and from coast to coast. It is about four inches long, including the one and a half-inch tail.

The short-tailed shrew (*Blarina brevicauda*) is a slate-colored animal, five inches long, found throughout eastern North America.

The pigmy shrew (*Microsorex hoyi*) is probably the world's smallest mammal. It is only three inches long, including an inch-long tail. It too lives in eastern North America.

The marsh or water shrew (*Neosorex palustris*) is the largest of the family, six inches long, with a two and a half-inch tail. Its large hind feet are fringed and partly webbed. It swims and dives with ease. Because of its speed and slight weight, it has even been seen to run over the surface of the water, upheld by surface tension. It is found in the colder portions of eastern and western North America.

A NORTHERN SHRIKE AND ITS PREY



The "butcherbird" earns its name, as this photograph shows. The bird has caught a field mouse in its strong hooked beak, and has impaled it on a thorn. It also eats insects, lizards, frogs, and English sparrows.

SHRIKE. The "butcherbird," as the shrike is commonly called, hangs its victims—field mice, frogs, small birds, lizards, or insects—on thorns or barbed wire, or fastens them in a tree crotch, the better to tear them in pieces. This peculiar habit is due to the fact that the shrike's claws are small and weak, and so it must have some way of holding its food while it tears it into pieces small enough to eat.

Shrikes have few likable traits. They are regular "bluebeards" and often kill for the mere love of killing. As a family, they are classified with songbirds, but the call note is harsh, and only a few species sing.

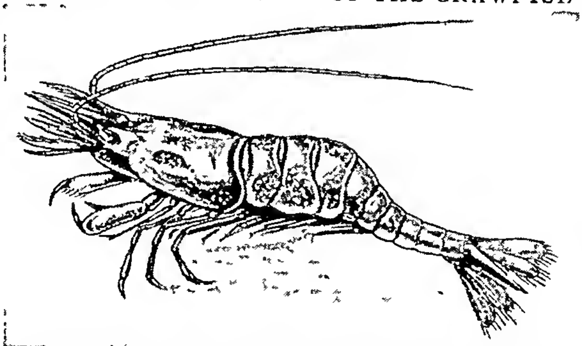
These birds are about ten inches long. The plumage, never bright, is generally gray or brown. Sometimes this is varied with black and white. The sexes are usually alike in coloring. The bulky nest is placed in a tree, generally among thorny twigs or intertwining vines. The eggs, four to seven in number, are white and are spotted with olive brown.

Shrikes are widely distributed throughout the Northern Hemisphere, and in parts of the African and Indo-Malayan regions. In the Western Hemisphere none are found south of Mexico, and but two species occur in America, the northern shrike and the loggerhead shrike. Of these the loggerhead shrike is the more southern form and the best known. (For illustration in color, *see* Birds.)

Of the Old World species the "great gray shrike" of Europe is the best known. It is pearl gray and white, with black wing and tail feathers. The small "red-backed shrike" is found in Great Britain. The male of this species is brightly colored. It has a gray head and neck, rust-red back, and pale rose breast. The female is dull brown. The scientific name of the northern shrike is *Lanius borealis borealis;* of the loggerhead shrike, *Lanius ludovicianus ludovicianus.*

SHRIMP. Shrimps, of which there are many varieties, are close relatives of the crawfish, belonging to the class of crustaceans. Their home, however, is in salt water. Shrimps are from two to ten inches long, have paddlelike legs for swimming, long delicate feelers on the head, and a humpbacked grayish-green body ending in a finlike tail. In spring and summer they take to deep water to spawn. Later the young migrate to warm, shallow coastal waters, only to return again to the open sea as they mature.

A SALT-WATER COUSIN OF THE CRAWFISH



This is what a shrimp looks like in its native waters. When cooked, it resembles a small pink doughnut, because heat colors the flesh and curls up the body. After cooking, shrimps are shelled and the sand vein, or intestine—the dark line running down the back—is removed. The flesh of the shrimp is rich in iodine. This accounts for much of its characteristic flavor. Shrimps and their relatives the prawns are among the most popular of all sea foods.

In the United States the largest shrimp fisheries are off the south Atlantic and Gulf states and on the Pacific coast. Trawling is most commonly used by commercial fishermen for taking shrimp (*see* Fisheries). Most of the catch is marketed fresh and frozen. In recent years, the sale of frozen breaded shrimp has expanded greatly. Large quantities of shrimp are canned and a portion of the catch is dried. Prawns are close relatives of the shrimps. Some reach a length of 20 inches. The scientific name of the common shrimp is *Crago septemspinosus;* of common prawn, *Palaemonetes vulgaris.*

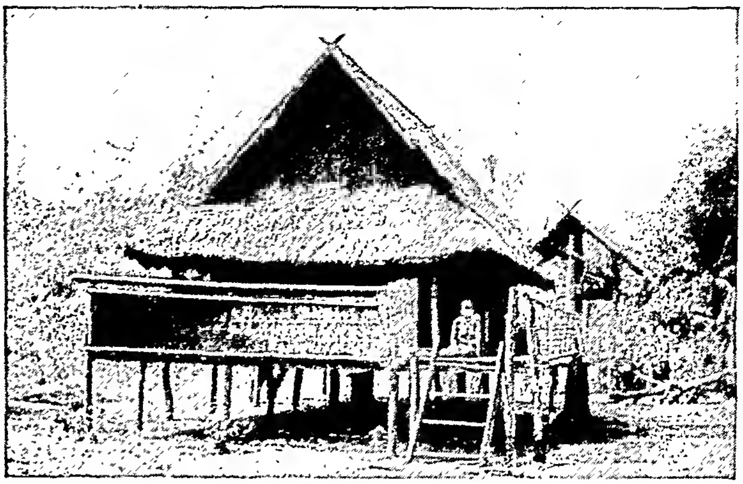
The LAND *That Is Named for* FREEDOM

Extent, Area, Population.—North to south, about 985 miles (600 miles in southern peninsula); east to west, about 510 miles. Area, about 200,000 square miles (excluding areas claimed by both Siam and French Indo-China). Population (1947 census), 17,324,581.

Climate.—Monsoon type. Annual precipitation in south, about 50 inches; in north, about 42 inches. Temperature, wet season, 65° to 85°F.; dry season, 100°F.; extreme (April).

Cities.—Bangkok (capital, 827,290). No other cities or large towns.

SIAM, or THAILAND (*tī'lănd*). The only nation in southeast Asia that has never been ruled by a European power is the kingdom of Siam. It commemorated this independence in 1939 by taking the name *Muang Thai*, or Thailand, which means "land of the free." When forced to be an ally of Japan in the second World War, it no longer felt "free" and resumed the name Siam. In 1949 it restored the name Thailand, but its historical title of Siam continued in wide use.

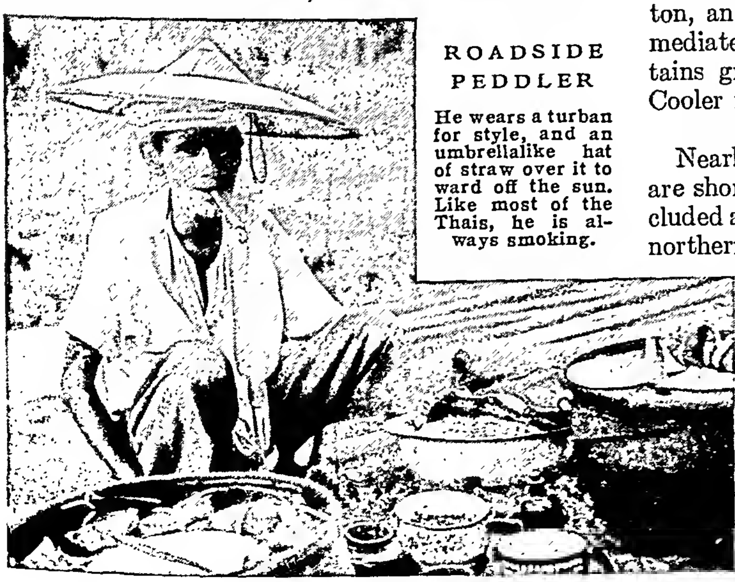


This native home is roofed with thatch, and has open sides for ventilation during the steaming-hot wet season. It stands on pilings, to keep the interior dry when heavy rains set the ground awash.

The first Siamese were probably a Chinese people, who entered the peninsula from the north early in the Middle Ages. Guarded by the northern mountain barriers, the Siamese pushed their rule south to the sea.

On the west, a long jagged mountain range separates Siam from Burma, then runs down the Kra Isthmus—the northern half of the Malay Peninsula. In the main part of the country two broad valleys lie east of this range with low mountains between. The western valley, drained by the Menam River, is about 60 miles wide. The eastern valley slopes from a curved western rim down to the Mekong River. The whole has an area about equal to that of the Atlantic states from North Carolina through Florida. It lies in about the same latitude as Central America.

The valleys are kept fertile by the monsoon climate. Monsoon rains give a wet season from May to October, and dry weather otherwise, with one exception. On the east coast of the Kra Isthmus, the seasons are reversed. Inland, the climate is steaming hot in the wet season, but 20 degrees or so cooler in winter. Night temperatures may fall 30 degrees.



ROADSIDE PEDDLER

He wears a turban for style, and an umbrellalike hat of straw over it to ward off the sun. Like most of the Thais, he is always smoking.

The high western range takes much of the rain, and so the large valleys receive only about 50 inches a year. But thunderstorms in the dry season keep the rain steady enough in the south to support a forest. In the mountainous north, the rainfall diminishes sharply; rivers may even lack water in the dry season, and boats are stranded until the next rains.

Throughout the hot, wet forest region Siam has the typical Indo-Chinese plants and animals, such as mangroves on the coast, palms, the tiger, the rhinoceros, and the elephant. White (albino) elephants, which are occasionally found, are considered sacred. In the cooler, drier north, the growth runs to teak, bamboo, grass, and scrub. The Kra Isthmus in the south is tropical enough for rubber growing. Here, too, is most of Siam's mineral wealth, largely tin, which is found in stream gravel.

The central valleys are suitable for rice and cotton, and the flat land makes irrigation easy. Intermediate levels between these valleys and the mountains grow tea, and hillsides are terraced for rice. Cooler northern valleys raise beans, peas, and corn.

The People and Their Lives

Nearly nine tenths of the people are Siamese. They are short and stocky with slightly slanted eyes. Included among the Siamese are the tattooed Laos of the northern and eastern mountain regions. Some half million Malays live in the south. The Chinese inhabitants are variously estimated at from half a million to a million.

More than four fifths of the people live in farming villages, usually along a river. Only about a tenth of the total land area is cultivated, and of this about 90 per cent is in rice. Each village has a *vat*, or Buddhist temple. Houses are set up on piles, with a huge thatched or tiled roof and walls of mats or slats. Formerly both men and women wore a

bloomerlike *panung*, with a shirt. Today women are turning to the *pasin* of shirt and skirt. The principal foods are rice and fish, with some fruits and vegetables. Pigs and chickens are raised for Chinese use, as the Buddhist Siamese dislike killing animals.

They do little handiwork except metal-working, notably silver hats, and some spinning and weaving. But nearly everyone plays a musical instrument, and likes to improvise poetry. They are devoted to dancing, shadow plays, and festivals, but in recent years the motion picture has been the favorite amusement.

THE FAITH OF BUDDHA DOMINATES BANGKOK

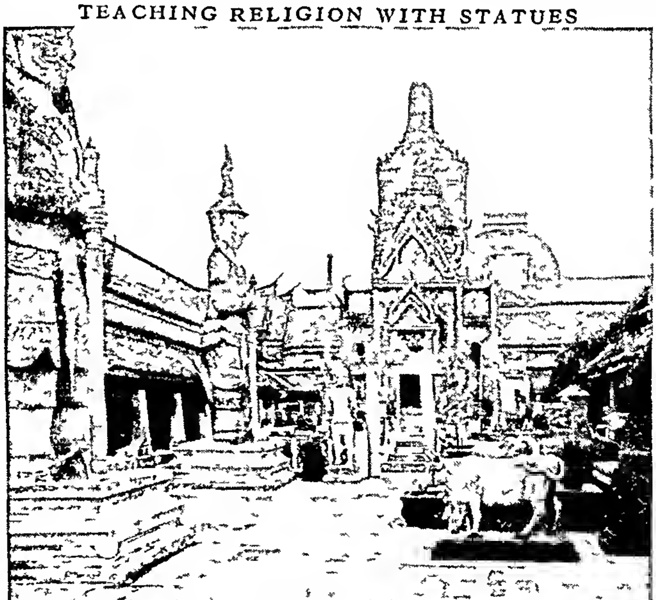
From everywhere along the waterfront of the capital city, the faithful see the porcelain pagoda Vat Arun, often called Vat Chang.

The liberty-loving Siamese will leave the land for office employment or government service, but until recently they scorned to work in trade or industry. Hence most of Siamese business fell into the hands of Chinese or whites. The chief industries are rice milling, teak lumbering, and tin mining. Deposits of tungsten ore, zinc, antimony, gold, iron ore, and coal are little developed. Minerals and the forests, which cover nearly three-fourths of the land, are worked under state concessions. The government operates some industries, such as milling sugar and making paper.

Siam usually grows about 3 per cent of the world's rice. Since tropical diseases keep the population down, there is a large surplus of rice for export. Other exports are tin, teak, gold, and rubber. The principal imports are cotton goods, foodstuffs, and petroleum products.

Most of the industry and commerce are centered in the capital, Bangkok (*see* Bangkok). A fine state-owned railway system of some 2,000 miles fans out from Bangkok to principal trade centers and down the Kra Isthmus. Otherwise, rivers and canals carry most of the local traffic, except where air lines operate.

TEACHING RELIGION WITH STATUES



As worshipers enter this temple in Bangkok, they pass statues of figures from the ancient epic of the 'Ramayana'. The huge demons at the left are of brick covered with glazed tile.

Education has been compulsory since 1921, and is slowly decreasing the high illiteracy. Most rural schools are still in monasteries but are state controlled. Vocational training is emphasized everywhere to prepare Siamese for trade and industry. At Bangkok is Chulalongkorn University, founded in 1917.

Public health is a critical problem. The government, Red Cross, and Rockefeller Foundation have established rural clinics to combat malaria and other tropical diseases. In 1914 a national law made vaccination compulsory.

A Troubled History

The early Siamese made their first definite mark in history in 1238, when they seized a northern portion of the old Khmer or Cambodian kingdom. Thereafter they gradually extended their holdings, until they dominated the Indo-Chinese peninsula, as the kingdom of Siam.

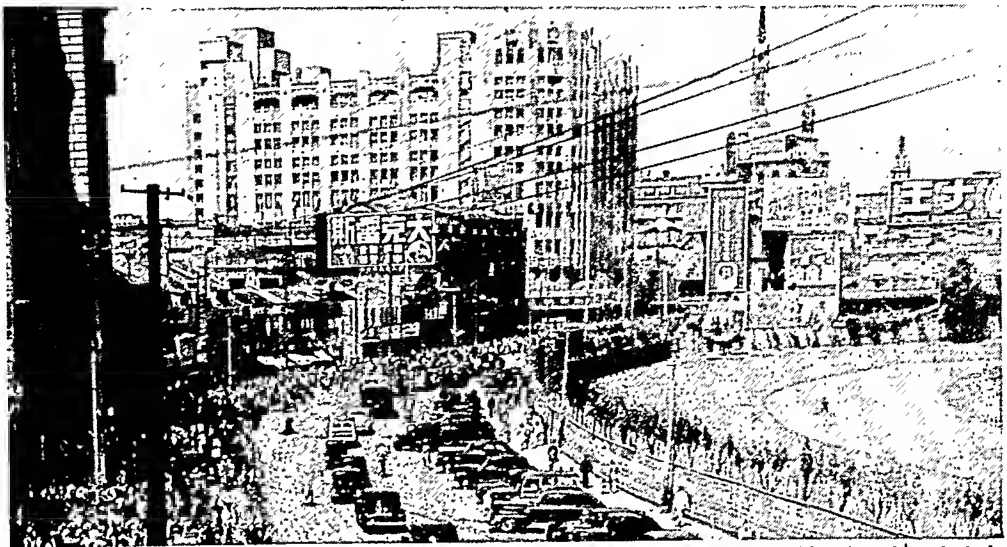
Since Siam was not an important source of trade, European nations did not interfere with it until the British began conquering Burma in 1824, and the French began encroachments in Cochin-China in 1862. Thereafter each neighbor periodically lopped off portions of the land, until Britain and France agreed in 1896 to keep Siam between them as an independent buffer state. In 1907 Siam exchanged some territories with France, and in 1909 ceded to Britain its sovereignty over northern Malay states, in return for British abandonment of special privileges.

Siam entered the first World War on the Allied side, and thereafter a spirit of nationalism and desire for progress asserted itself. On June 24, 1932, a peaceful revolution replaced absolute royal rule with a limited monarchy, a legislature, and universal suffrage. King Prajadhipok abdicated in 1935 in favor of his nephew,

the then nine-year-old Ananda Mahidol. In the second World War, Siam (then Thailand) played an odd role. It sought the friendship of both Britain and Japan by signing non-aggression treaties in 1940. But after the Japanese invasion of French Indo-China in 1941, the Siamese also invaded the country. France agreed to its demands for parts of Laos and Cambodia.

Then Siam itself was invaded by the Japanese, and soon surrendered on Dec. 8, 1941. Japan forced the Siamese to become its allies under a military treaty. On Jan. 25, 1942, the Siamese declared war on Britain and the United States. The United States, however, never recognized the declaration of war made under duress. In Japanese operations against Burma and Malaya, Siam served as a major base.

BANGKOK, THE CAPITAL CITY



Western automobiles line the main avenue of Bangkok while jinrikishas and bicycles thread their way left of the streetcar tracks. In Bangkok's area of some ten square miles are many parks like the one at the right. Modern buildings tower over old bazaars.

Although Premier Pibul Songgram collaborated with the Japanese, the people were hostile to their conquerors and a widespread resistance movement grew. In an attempt to win favor, Japan in 1943 ceded parts of Burma and Malaya to the Siamese. Using forced labor, Japan built a railroad to Burma; tens of thousands of war prisoners died while working in the jungles and swamps.

In 1946 the Siamese signed a treaty with Britain and returned conquered territory. A new constitution in 1946 abolished royal appointment of half the members of the Assembly and provided for their popular election. It established an Upper House. When King Mahidol was killed, his brother, Phumiphon Adundet, became ruler. The Siamese then returned to Indo-China the territory they had annexed. That same year, 1946, Siam joined the United Nations.

By 1948 it had largely regained its prewar prosperity. Recovery was aided by the United States, which bought Siamese rice for relief in Asia and rubber and tin for stockpiling. The Siamese co-operated with the British in combating Communist guerrillas in Malaya and sent a force to aid the United Nations in Korea. In 1950 Phumiphon Adundet returned from a Swiss school and was crowned King Rama IX, but the army became the real power. Siam got American arms aid in 1953, and in 1954 was the first nation to announce it would join a defense pact against Communism in Asia.

SIBELIUS, JEAN JULIUS CHRISTIAN (born 1865). To the world, Sibelius was one of the great composers of symphonies. But to his fellow Finns he was far more. They revered him as one of Finland's greatest patriots. His strong, surging music roused national fervor, helping the Finns to preserve their spirit despite the iron rule of Russia (1809–1917). His tone poem 'Finlandia' is one of the noblest expressions of love of country in all music or literature.

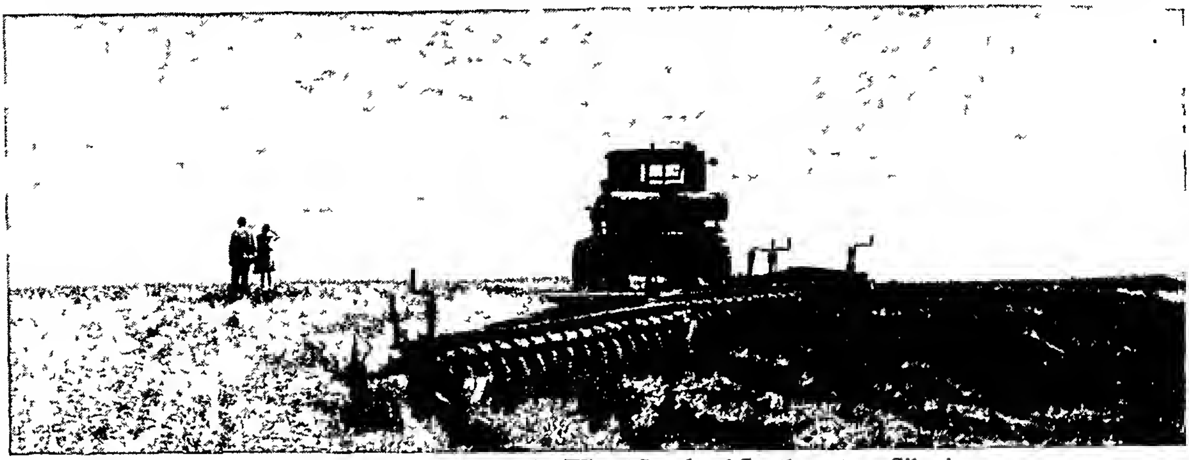
Sibelius was born in Tavastehus, Finland, on Dec. 8, 1865. His father was an army surgeon who died when the boy was two. Jean was reared by his mother and grandmothers. At school his favorite studies were Greek, Latin, and Scandinavian literature. He became a skilled hunter, and collected plants. But music was always his chief interest. When he was nine years old, he studied the piano, and when 15, the violin. His ambition was to be a concert violinist. After a year of law at the University of Helsinki, he turned to music.

JEAN SIBELIUS

Sibelius' music told of Finland's rugged grandeur and long history.

After four years at Helsinki Conservatory, he studied in Berlin and Vienna. In 1892 he completed his symphonic poem 'Kullervo', based upon the great Finnish 'Kalevala' epic. The work brought him instant fame. The same year he composed 'En Saga' and taught at Helsinki Conservatory. In 1899 he wrote 'Finlandia'. The Russian government feared the nationalism of the music and forbade its performance. In Berlin it was played as 'Vaterland'; in Paris, as 'Patrie'. He also published the first of his seven symphonies in 1899. In 1914 he came to the United States to conduct an all-Sibelius concert at the Norfolk Festival in Connecticut. Yale University granted him an honorary degree.

The VAST EXTENT *and* RESOURCES *of* SIBERIA



Mechanized Farming on the Wheat Lands of Southwestern Siberia

SIBERIA. Most people think of Siberia as a land of frozen wastes and snow-covered forests where wolves hunt down luckless travelers. They think of it as a region of vast distances and bitter cold—populated chiefly by wandering tribes, political exiles, convicts, and victims of forced labor.

These popular ideas have a basis of fact. Northern Siberia has the coldest spots on the globe, and Siberia has been a place of exile for many generations. But Siberia is far more than this. It is to the Soviet Union what the Far West once was to the United States. It is a fast-developing frontier region of immense resources, of varied climates, and of vast possibilities for the future. It has many cities with populations of between 100,000 and 750,000, and people are pouring into it as they once did into the American Far West. Mines and forests provide the materials for manufacturing industries that are growing at a prodigious rate.

Siberia is an immense region. It includes nearly a third of all Asia, and it is larger than Europe by more than a million square miles. From west to east it stretches 4,000 miles, as far as from Seattle to the eastern side of Greenland. But it is still thinly settled. Though it has more than half the land area of the Soviet Union, it has only about a sixth of the population. (For map, *see* Russia.)

Extent.—West-east, nearly 4,000 miles (Ural Mountains to Pacific Ocean north of Kamchatka), north-south, generally about 1,700 miles. Administrative-territorial divisions are: Urals, Eastern Siberia, Western Siberia, and Far East (including Sakhalin and Kurils. Area, about 5,216,200 square miles. Population of Asiatic U.S.S.R. (1950 est.), 38,400,000, including region of Siberia (1947 est.), 15,550,000.

Climate.—Average temperature above freezing only from April (in the south) or June (north) to October (south) or September (north). Coldest point, Verkhoyansk, with an annual mean of 3.6°F., a January mean of −58°, and a July mean of 60°. Warmest points, Barnaul and Khabarovsk, with an annual mean of 34°F., a January mean of about −10°, and a July mean of about 69°. Precipitation (mostly in summer months) from 20 inches a year in extreme west and southeast to less than 5 inches a year in northern portion of the Lena Valley.

Cities.—Novosibirsk (750,000), Sverdlovsk (600,000), Chelyabinsk, Omsk, Molotov (500,000 to 450,000); Irkutsk, Khabarovsk, Krasnoyarsk, Vladivostok, Nizhni Tagil, Barnaul, Kemerovo, Magnitogorsk, Stalinsk (300,000 to 200,000), Chita, Komsomolsk, Prokopievsk, Tomsk, Ulan Ude, Zlatoust (about 150,000).

Regions, Climate, and Soil

The word "Siberia" has different meanings. The Soviet government uses it to mean only certain administrative regions. But geographers use the word to mean all Russian Asia, except the dry region east of the Caspian Sea (comprising roughly the Kazakh Soviet Socialist Republic and the small republics south of it).

Siberia, in this broader sense, consists of three belts running east and west: Arctic desert in the north, forest in the middle, and farming land in the south. The differences in these belts are caused by differences in climate.

Because of its immense size—one tenth of all the land of the globe—Siberia is unique in its climate Because most of it is so far from the ocean, it is little affected by oceanic winds. It makes its own climate, so to speak, and, more than that, it is a principal factor in creating the monsoon climates of China, the Indian peninsula, and the Indo-Chinese peninsula (*see* Climate; Winds).

In winter the land everywhere becomes intensely cold. Indeed, scientists call the region around Verkhoyansk in eastern Siberia "the cold pole of the earth." But the air remains calm, except for occasional blizzards called *burans* or *purgas* It does not pierce buildings or fur clothing, and the cold is bearable.

In summer the long hours of sunshine heat the air and make it rise Heavier, cooler air flows in from every direction, bringing moisture with it. The ground thaws and plants grow, according to the amount of heat received in the various latitudes.

In the northern belt of Arctic desert, the surface is thawed for only a brief summer period. Here only mosses and lichens can grow. The middle belt gets warmth enough to grow forests of pine, fir, and larch, with some aspen, birch, and alder. But the soil, as in most pine-forest regions, is thin, acid, and of little use for growing crops (*see* Soil). In the third belt, the southern, a longer growing season with little rain produces richer soil, and here good crops can be grown.

Beneath a thin cover of soil, Siberia is practically one huge slab of rock, which is lowest in the west and northwest, and rises gradually to its edges in the southeast and south. Hence the rivers flow north or northwestward toward the Arctic Ocean, except along the Pacific coast. Around the inner edges of the slab, the highest mountains of Asia are draped in curves. Geologists explain this by saying that this Siberian slab has existed since the early days of the earth, and the surrounding mountains have been pushed up against the edge of the slab.

Minerals are scattered throughout Siberia. The richest deposits are in the Urals in the west. The next richest area lies along the northwestern edge of Mongolia. Coal, iron, and low-grade manganese ores are abundant. Other coal and iron areas are near Lake Baikal, and on the upper Bureya River near Komsomolsk in the Far East. The gold-bearing gravels of the rivers around Yakutsk are exceptionally rich. There are also scattered deposits of lead, zinc, tin, and tungsten. Coal and petroleum are obtained from Sakhalin Island in the Pacific Ocean.

A SCHOOL FOR YOUNG MONGOLS

A log schoolhouse, under the sign of the Soviet star, helps to win children of the Buriat-Mongol Republic to Soviet ways of life.

Peoples and Early Settlement

Before the 17th century, Siberia was inhabited by peoples of Finnish, Tatar or Turkic, and Mongolian types. Finns, Samoyeds, Yakuts, and Tungus lived in the Arctic tundra. The Tatar or Turkic peoples lived in the west. One of their towns, Sibir, near the modern Tobolsk, gave its name to the entire region. The Mongolian peoples occupied the eastern portion.

The first Russian movement to the east was made to beat back the constant Tatar invasions. After Sibir came under Russian rule in 1582, the Russians pushed eastward along the southern belt of good land, engaging in the fur trade. Later, criminals and political offenders were sent into exile along the same route. The region was opened wide to Russian settlement when the Trans-Siberian Railroad was built between 1891 and 1905. Most of the people still live along this railroad and its spurs.

Free peasants were not admitted to take up land until serfdom was abolished in 1861. Thereafter the czars made intermittent attempts to encourage colonization. In all, about a million Russians entered during the 19th century; but only a fourth were free settlers.

Recent Development

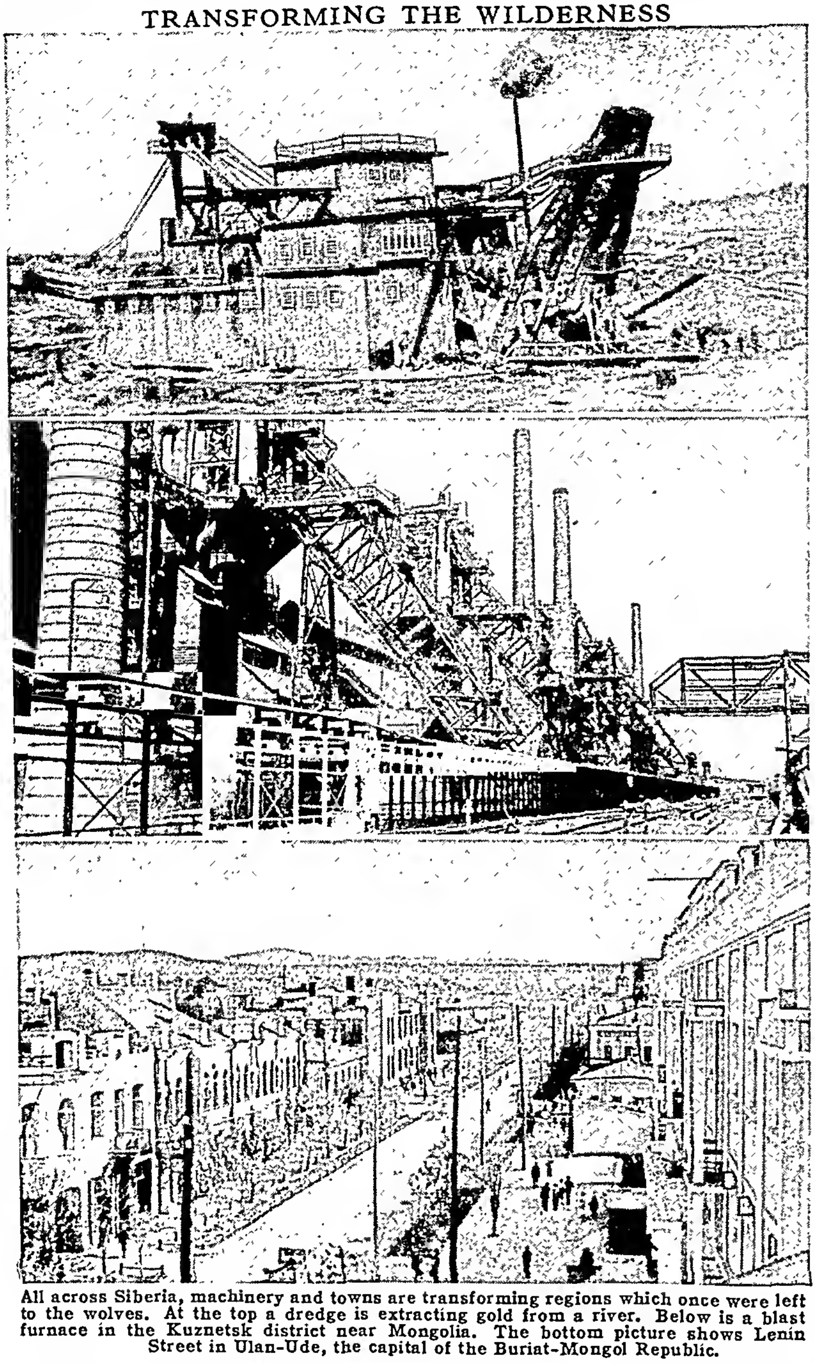
After the Soviet government was established in 1917, it gave intensive attention to Siberia. It wished to develop new centers based on communist principles, to provide land for peasants, and to have sources of military strength far from Europe. From the start, the government dealt intelligently with its three handicaps—diverse races, limited transportation to serve vast distances, and unfavorable climate with only a little good soil. To deal with minority peoples, it granted considerable local autonomy in government.

Education was encouraged and efforts were made to stimulate native output of furs and foods; but native languages, customs, and ways of living were respected. To promote development of the country, the government added branches to the 3,886-mile main line of the Trans-Siberian Railroad from Chelyabinsk to Vladivostok. It also started a second line from Taishet near Irkutsk to the lower Amur River, as a safeguard against enemy seizure of the vulnerable main line along the upper Amur. To serve northern Siberia, ice-breaking ships

FORMER NOMADS TAKE TO VEGETABLE GROWING

Here the Soviet program for developing Siberia has won over some Mongol women from their ancestral ways to life on a collective farm.

TRANSFORMING THE WILDERNESS



All across Siberia, machinery and towns are transforming regions which once were left to the wolves. At the top a dredge is extracting gold from a river. Below is a blast furnace in the Kuznetsk district near Mongolia. The bottom picture shows Lenin Street in Ulan-Ude, the capital of the Buriat-Mongol Republic.

plied the Arctic Ocean. They delivered supplies and picked up timber, furs, and other products which were moved down the rivers during the navigation season from June to September. Airplane transport was developed to all the principal cities and towns.

To make the best use of the scarce good soil, agricultural experts studied the possibilities of the various regions and started projects to grow suitable crops and animals. Hence there is much specialization in different parts. Chief crops are wheat, especially in the southwest, oats, barley, rye, and vegetables. Dairying has come to be a large industry in the west, and Siberian butter has become world-famous.

Three Great Divisions

Siberia falls naturally into three great divisions—western, central, and far eastern. The western portion extends from the Urals to the Yenisei River. It is drained largely by the Ob River and its branches. Most of it is low, and swampy when not frozen, but it rises sharply in the southeast, up the Russian side of the Sayan and Altai mountains. This mountainous district and the Urals, to the west, are among Russia's richest sources of minerals. The two districts work conveniently together, since the Urals have more iron than coal, while the Sayan-Altai (or Kuznetsk) district has an excess of coal. By carrying iron ore east and coal west, maximum output can be obtained from each district.

In the Urals is the second largest city in Siberia, Sverdlovsk. Other centers in the Urals are Chelyabinsk, Molotov, Nizhni Tagil, and Zlatoust. Novosibirsk, the point of entry for the Sayan-Altai district, is Siberia's largest city. Other cities here are Stalinsk, Kemerovo, Prokopievsk, and Leninsk-Kuznetski. From Novosibirsk the Turkestan-Siberian Railroad runs south to tap the mineral wealth in the Kazak Republic. Some important Siberian cities along this line are Barnaul and Biisk. Other large cities of the region are Omsk, Tomsk, and Krasnoyarsk.

The central region is drained by the eastern branches of the Yenisei River and the tributaries of the Lena. This region is mountainous in the south, and it is rugged nearly to the Arctic Ocean. Most of the Lena River basin, with a larger area to the northeast, is organized as the Yakut Autonomous Republic. It is left largely to the native Yakuts and Tungus, except for gold mining, timber cutting, and fur collecting along the Lena and its branches. Coal and petroleum exist in the north.

The most valuable part of this central region is that around Lake Baikal, the largest freshwater lake in Asia (13,200 square miles). Coal and iron support a metals industry at Irkutsk, with related industries at Chita. Near by is the autonomous Buriat-Mongol Republic, with its capital at Ulan Ude.

The far eastern region comprises the lands which drain into the Pacific. Because of the enormous distance from European Russia, the government determined to make the region as self-sufficient as possible.

The difficulties were great. Most of the Pacific coast is icebound several months every year. Everywhere water pipes must be laid in conduits that can be heated in winter. Roads and ports were few. The population was sparse and backward. But the threat of Japan's expansion from Manchukuo, in the 1930's, spurred development. Workers came from Russia and built farms, roads, and cities, especially in the Amur River valley. Komsomolsk, built by the Russian youth organization, and Khabarovsk became industrial centers. They smelted iron and refined petroleum from Sakhalin Island. Sovetskaya Gavan and Nikolaevsk supplemented the port at Vladivostok. Development of the regions was swift enough to help supply Russia in the second World War. (*See also* Kamchatka; Vladivostok; and *see* **Siberia** in the FACT-INDEX.)

SIBYLS (*sĭb'ĭlz*). According to an old Roman tradition, the Cumaean Sibyl or prophetess came from the east to the Roman King Tarquin the Proud, offering nine books of prophecies but at so enormous a price that he refused to buy. She then destroyed three, and offered the remaining six at the same price, and was again refused. Destroying still another three, she asked as much for the three left and Tarquin's fear and curiosity finally induced him to buy. They contained advice regarding the religion and government of the Romans and were carefully guarded in the temple of Jupiter and consulted on occasions of national emergency. When the temple was burned in 83 B.C. a new collection was made of about 1,000 lines, gathered from all the cities of Greece, Italy, and Asia Minor, which was kept until some time between A.D. 404 and 408, when the Christians caused it to be publicly burned.

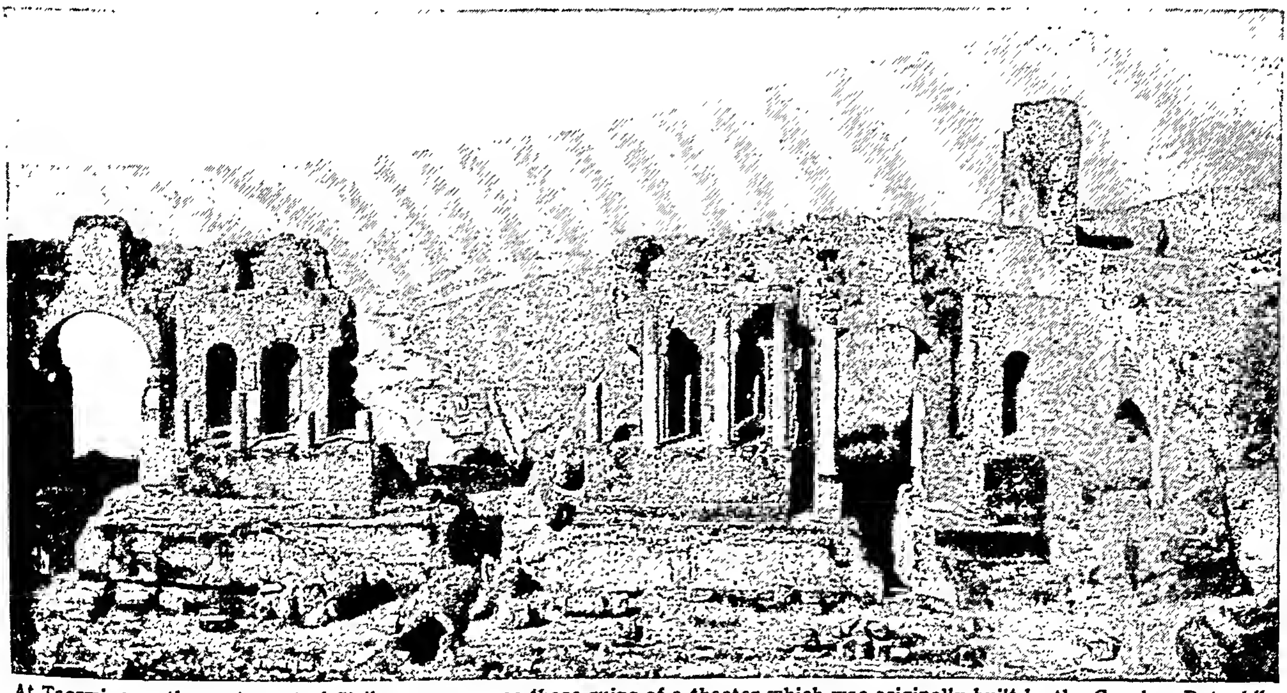
Several other sibyls or inspired prophetesses are named by various Greek and Roman writers. Legend said they lived to an incredible age. The Sistine Chapel in Rome contains world-famous wall paintings by Michelangelo of the Cumaean, Delphic, Persian, Libyan, and Erythraean sibyls.

SICILY (*sĭs'ĭ-lĭ*). From the center of the Mediterranean Sea rises the mountainous island of Sicily. Since the beginning of history it has been a battleground. Again and again armies from Europe, North Africa, and the East have swept over it in the struggles to control these strategic waters. Surpassing all previous invasions, British and United States forces in the second World War seized it as a steppingstone into Italy.

A glance at a map of Europe shows why Sicily has so often been a prize of war. It thrusts up like a wedge between North Africa, some 90 miles to the southwest, and Italy, only two miles to the northeast across the Strait of Messina. This position gives Sicily command of ship and air lanes between southern Europe, Africa, and the Middle East.

Sicily is shaped like a rough triangle, the sides indented by scores of harbors. Ancient poets called it *Trinacria*, from the Latin words meaning "three points." Its greatest length is about 170 miles. In width, it reaches about 140 miles. With a total area of 9,935 square miles, it is about the size of Vermont, and is the largest of the Mediterranean islands. Around the rim of Sicily runs a narrow coastal plain,

A RUINED MEMORIAL OF THE DAYS OF THE GREEKS



At Taormina on the east coast of Sicily, you may see these ruins of a theater which was originally built by the Greeks. But while the columns are Greek, the arches you see are Roman, for the original theater was entirely reconstructed by the Romans. From these ruins you get a beautiful view of Mount Etna in the background.

which in the east and west broadens into low pockets. Mountains, cut by few passes, cover the north. The highest peak is volcanic Mount Etna, about 10,750 feet (*see* Etna, Mount). The mountains shelve southward into broad plateaus about 1,600 feet above the sea.

Green Fields and Orchards

Crops rise in bright tiers. The green of truck farms mantles the lowlands. On the slopes rise vineyards and orchards, groves of lemon, orange, tangerine, and gray-green olive trees. The high slopes and plateaus are golden with vast wheat fields, covering a third of the land. After the Saracens seized Sicily in the 9th century, they inscribed a palace wall in the city of Palermo with the words: "Europe is the glory of the world, Italy of Europe, and Sicily the fairest garden of the Mediterranean."

Today Sicily is crowded with 4,452,773 people (1951 census, preliminary)—about 450 persons to the square mile. Although 90 per cent of the land is cultivated, it rarely grows enough food for all. Summer drought, the worn soil, and old-fashioned farming methods produce small yields. Less than half the farmers own their land. About a sixth of the land is held by huge estates called *latifundia*. The Italian government promised to break up this feudal system but did little. After the second World War many hungry peasants seized land.

Most Sicilian farmers live in villages or towns, many six or seven miles from the fields. They jolt slowly to work in *carrettas*, donkey carts with high wheels spaced to fit the ruts left by Roman chariots. They paint the carts with religious and historic scenes, and decorate the donkeys with bright harnesses.

Cities Rise amid Ancient Ruins

The principal cities stand on the coastal plains of the north and east. Railways girdle the island to link them. The capital and largest city is Palermo, with a population of 482,594. It stands on a 12-mile bay in the orange-bowered Conca d'Oro, "Golden Shell." Palermo is a pageant of Sicily's history. Greek and Roman ruins lie near Moorish palaces, tombs of Norman kings, and French and Spanish churches. In the center of the city is the University of Palermo, founded in 1779. The streets teem with swarthy, dark-haired Sicilians and blond, blue-eyed Sicilians—descendants of the various conquerors.

At the northeast tip, Messina (population, 218,593) rests in the shadow of Mount Etna. A railroad ferry connects it with Italy. When the Greeks founded the city about 600 B.C., they called it Zancle, "sickle," for the arc of sand that forms the harbor. In the Strait of Messina lie the fabled rocks of Scylla and the whirlpool of Charybdis. Most of Messina was destroyed in 1908, when an earthquake killed 76,000 persons and injured 95,000. In the second World War Allied bombers severely damaged it.

South of Messina, the little tourist town of Taormina perches on the rocks, 700 feet above the Ionian Sea. Midway down the east coast stands Catania, second largest city, with 297,773 people. Its malarial plain was a bitter battleground in the second World War. To the south is Siracusa (Syracuse), now a city of only 70,060, including suburbs. In Greek times it was Europe's largest metropolis, with one million people.

Sicily's industries arise chiefly from agriculture. Tomatoes and artichokes are canned for export. A few factories make citric acid and essential oils from the citrus fruit. Cargoes of fruits and nuts, chiefly almonds, are shipped to Europe. The United States banned Sicilian fruit because it carried the destructive Mediterranean fruit fly. Sicily's most important mineral is sulphur, found mainly in the southwest. Until the Texas and Louisiana deposits were developed, Sicily was the world's chief source of sulphur. Fishing for tunny, coral, and sponges employs about 20,000 Sicilians.

Invasions Began 3,000 Years Ago

The original settlers of Sicily were people called Siculi or Sicani, who are thought to have crossed from the toe of Italy. They were pushed inland by the Phoenicians some 3,000 years ago. In the 8th century B.C. Greek invaders made Sicily a center of commerce and learning. The poet Theocritus and the philosopher Empedocles lived here. After five centuries came the Carthaginians, who soon had to yield to Rome. Vandals and Goths then crossed from the mainland to pillage and destroy. Byzantine emperors drove them out and ruled Sicily for 300 years.

In the 9th century Saracen invaders introduced irrigation and built up commerce. Two centuries later the Normans swept down, but in 1197 were overcome by the Hohenstaufen dynasty, which developed Sicily into one of the first of the modern states. In 1266 Charles of Anjou seized power. His cruel reign ended in 1282 on Easter Monday when the people of Palermo massacred 4,000 of their French oppressors as the vesper bells were ringing. After the "Sicilian Vespers," other cities revolted, and Sicily won independence, choosing Pedro III of Aragon as king.

Spanish, French, and Austrian despots then brought darkness and stagnation. In 1734–35 Don Carlos established the Bourbon dynasty in Naples and Sicily, uniting the two territories in the Kingdom of the Two Sicilies. Bourbon kings ruled until 1860, when Garibaldi won Sicily for the realm of Victor Emmanuel, which a year later became the Kingdom of Italy (*see* Garibaldi).

The Scourge of the Mafia

Bourbon misrule led estate owners to hire ruffians to protect their possessions from desperate peasants. These guards soon formed the Mafia, a society that took the law into its own hands. The Mafia spread through all classes and its violence terrorized the island. Immigrants set up scattered units in the United States. Late in the 19th century the Italian government broke the wide power of the Mafia, but remnants lingered on in parts of Sicily.

SIEGFRIED (*sēg'frēd*). Long, long ago, in a gloomy cave hidden away in the forests of the Rhineland, there lived Siegfried, a kingly youth, tall and strong, with fair hair and blue eyes. His only companion was Regin, a swarthy dwarf who had reared him.

When Siegfried attained manhood Regin told him of his parentage, that he was the orphaned son of a fearless king who had died gloriously in battle. "The time has now come," Regin said, "when you must leave the forest and go in search of adventure in the world." Nothing loath, Siegfried prepared to depart, but first he asked that Regin make him a trusty sword. Regin, who was a skilled smith, straightway began to forge a sword for Siegfried, but when he had finished it the youth easily shattered it by striking it on the anvil. Three others met the same fate.

"If I am to do battle," said Siegfried, "I must have a sword worthy of my strength." Thereupon Regin took the broken pieces of the sword which had belonged to Siegfried's father, filed them into steel dust, and from this with all his art he made a wonderful shining blade. This also Siegfried tested by bringing it down with a mighty blow on the anvil. It was not broken, but the anvil was cut in two.

Fafnir, the Terrible Dragon

In the long evenings Regin had told Siegfried of the fearful dragon Fafnir who guarded in his cave a priceless treasure, slaying those who tried to gain it. To the den of the dragon Siegfried now made his way. When Fafnir heard him approaching he roared until the ground trembled. Nothing daunted, Siegfried guarded himself from the maddened rushes of the hideous creature, until with a thrust of his sword he so wounded the dragon that it at last fell dead. Siegfried thus gained the treasure which the monster guarded. By bathing himself in the blood of the slain dragon he became proof against wounds, excepting in one small spot between the shoulders where a linden leaf had fallen. Accidentally tasting the blood, he discovered that he was able to understand the language of the birds and beasts, and by eating the monster's heart he was endowed with even greater strength. According to another story the treasure which Siegfried gained was obtained by slaying the kings of the Nibelungs (*see* Nibelungs, Song of the).

After performing many other great feats Siegfried at last came to the court of Gunther, king of the Burgundians, where he was greeted as a hero, with feasts and all honor. He wedded Kriemhild, sister of Gunther, a maiden of marvelous beauty, and became the most heroic and beloved knight in Gunther's kingdom. But among the king's vassals was one, Hagen by name, who was jealous of Siegfried's glory. By clever lies he induced Gunther to believe that Siegfried would some day steal his power, so the king agreed to help destroy Siegfried.

Knowing that there was but one place in which Siegfried could be wounded, Hagen treacherously played upon Kriemhild's fear for Siegfried's safety on the battlefield, and begged her to tell him of the fatal spot, saying, "I ride close behind your lord in battle, and should the fight wax fierce, knowing his vulnerable spot I might protect him." Kriemhild innocently disclosed the secret, and unknown to Siegfried she sewed a tiny cross between the shoulders of his tunic. The dauntless hero thus became an easy prey to those who sought to slay him. Gunther arranged a hunt, and the cowardly Hagen thrust a spear into the fatal spot, while Siegfried lay drinking from a woodland stream. Mortally wounded, Siegfried attacked Hagen but died before he had avenged himself. The whole kingdom mourned Siegfried's loss, and it is said that even the gods sorrowed and there fell upon the earth a gloom that lasted for many days. This story is the theme of one of the musical dramas of the composer Richard Wagner.

SIERRA (*sĭ-ĕr'ȧ*) **NEVADA.** The loftiest and grandest mountain range in the United States, the Sierra Nevada ("snowy range") forms a great wall 400 miles long and 50 to 80 miles wide, in eastern California. A gap through which the Feather River flows separates it from the Cascade Range on the north. On the south it ends at Tehachapi Pass in Kern County. The rich Sacramento and San Joaquin valleys lie on its western side, their orchards and grainfields irrigated by the waters of its snow-fed streams. The eastern base springs from the deserts of the Great Basin, which is deprived of rain-bearing winds from the Pacific by this great rampart.

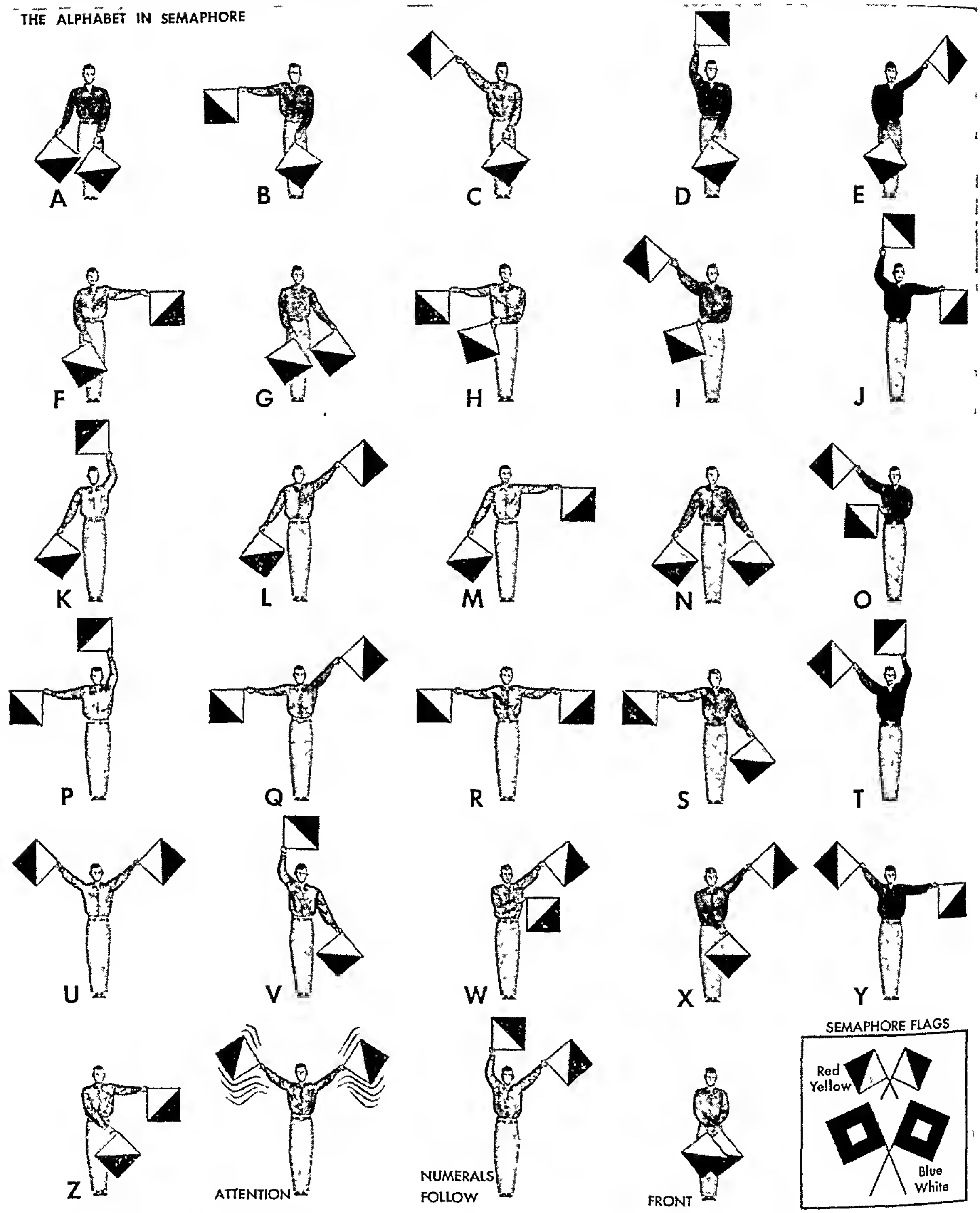
Along the jagged, snowy crest line 12 peaks rise more than 14,000 feet above sea level. Mount Whitney is the highest peak in the United States proper (14,495 feet).

The range is a giant block which was uplifted along its eastern edge and tilted to the west. The east side plunges abruptly to the plains 5,000 to 10,000 feet below. High on its rugged face, in a basin due to fracturing and slipping of the rock, lies beautiful Lake Tahoe. The longer, gentler west slope is scored with deep canyons and valleys carved by glaciers and rushing streams. The most famous is the Yosemite (*see* Yosemite National Park). The canyons of the Tuolumne, Kern, and Kings rivers are also notable. Dense forests mantle the western slopes to a height of 9,000 feet. Here are the giant sequoias, the largest trees in the world (*see* Sequoia). Three national parks preserve the glorious scenery of these mountains—Yosemite, Kings Canyon, and Sequoia (*see* National Parks). The range was named by the Spanish settlers after the Sierra Nevada in southern Spain, the highest mountain range in that country.

SIGNALING. As long as men have had language, they probably have also had some way to communicate with each other at a distance. The earliest methods of signaling were most likely arm gestures or other signs made with the body. From very early times primitive people used beacon fires and columns of smoke to carry messages. In the armies of ancient Rome trumpets gave the signal for a cavalry charge or an infantry attack. Bugles are used for many signals in the army and navy at the present day. The boatswain's pipe, a kind of whistle, has long been used in the navy. Signal guns, too, go far back in military history.

TWO WAYS FLAGS ARE USED IN SIGNALING

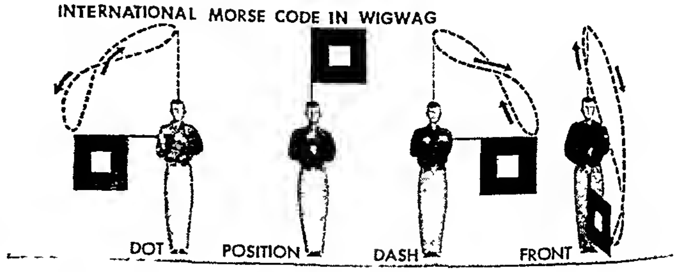
THE ALPHABET IN SEMAPHORE



In the fast *semaphore* system pictured above, the positions of two flags represent letters of the alphabet. "Attention" is used to attract the notice of another signalman, and "front" indicates the end of a word. Numbers are spelled out in the text of a message. But in the message heading (which gives date, time, and origin), the letters A to J stand for the numerals 1 to 0. When letters are to be used in this way, the signalman first makes the sign "numerals follow."

The slower *wigwag* system (right) is little used. It is simply a visual method of sending the International Morse Code. The signalman returns the flag to "position" between dots and dashes. "Front" is used as in semaphore.

INTERNATIONAL MORSE CODE IN WIGWAG



Today the telephone, telegraph, and radio carry messages farther and more swiftly than our forefathers could have dreamed. But many visual signaling systems are still in use and are of the greatest importance. This is especially true at sea, in military operations, and in weather bureau activities.

Signaling at Sea

Between ships at sea visual signaling is extremely important. Most nations use the International Signal Code. Signals are made with 26 alphabet flags in variously colored designs and certain pennants with special meanings. Messages are expressed by combinations of the flags and pennants. This code is translated into the languages of the maritime nations, so that sailors of any country may read the messages fluttering above the signal bridge.

The United States Navy has a signaling system based on its own code books for reports between ships. These books contain most of the usual messages, and so signals indicate only the book and message number. This system has a flag for each letter and numeral as well as several special flags and pennants. For signaling over short distances the semaphore system, illustrated on the opposite page, is much used. The wigwag system is now almost discarded because it is so slow.

Flashing Lights at Night

At night, lights replace flags. Red, green, or white stars are shot from a Very pistol. Parachute flares and smoke signals are fired from a mortarlike projector. Red or blue hand flares are also used. For ordinary purposes a blinker light is used to transmit the dots and dashes of the International Morse Code. Over long distances signalmen use a shutter-equipped searchlight. Over shorter distances they frequently use smaller lights equipped with key-operated switches. In war time, infrared light, invisible to the eye, is often used for blinker signaling.

Seagoing men use radio extensively in signaling and navigation. For long-distance transmission, messages are sent by International Morse Code (wireless telegraphy). Navy ships in the same formation often communicate by voice radio. Life at sea has become much safer through the use of radio. Weather reports and storm warnings are regularly broadcast to ships and airplanes (*see* Radio). The radio direction finder (RDF) and loran navigational equipment are widely used by ships (*see* Navigation; Radar).

International distress signals have saved the lives of many aviators and seamen. Most familiar to landmen is the famous "S O S" signal. This consists of three dots, three dashes, and three dots; it can be sent by radio or any other convenient method. Corresponding to this signal is the flag hoist "N C" in the International Signal Code. Aviators in distress use the word *Mayday* over voice radio. This word is simply an English respelling of the French *m'aider*, "help me." The signal is understood by aviators and mariners everywhere. Other distress signals are a gun fired repeatedly, flames of any sort, or a fog signal sounded continuously. The national ensign hoisted upside down is usually understood as a distress signal also.

In fogs and storms, lightships and shore stations send out signals at regular intervals by bells, horns, sirens, or whistles. Underwater signals made by a bell or oscillator are also used. The sending apparatus often marks a shoal or harbor entrance. Sound carries extremely well under water and the signal may be picked up by microphones on a ship far away.

Signaling on Land

In the United States Army, small units do their own signaling over short distances. Signaling between higher units is entrusted to the Signal Corps. The Army uses wire and radio telegraphy and telephone; messengers, such as motorcycle dispatch carriers and runners; homing pigeons; and visual signals, such as fireworks and signal lamps. A flier signals to the ground by radio, dropped messages, homing pigeons, fireworks such as Very shells, and by special movements of the plane in flight. Signaling from ground to airplane is done by radio, fireworks, signal searchlights, picked-up messages, or by rectangular panels of white cloth, laid on the ground in various combinations.

The Signal Corps uses the International Morse Code for both wire and radio telegraphy and for blinker signaling. In time of war all radio messages and most messages sent by wire are coded; that is, they are "translated" into a secret cipher or code before they are sent.

Boy Scouts and Girl Scouts use both semaphore and wigwag in signaling. They also use the Indian sign language, a method of hand signaling. Both organizations use red and white flags in signaling rather than the Navy flags pictured on the opposite page.

Railroads in the United States use both telegraph and radio for communication. Among railroad men "semaphore" refers to a system of signaling using movable arms. These are equipped with lights for night use. Semaphore signals along the track indicate whether a train may proceed or must stop. (*See also* Railroads; Locomotive.)

SILICON. The element silicon plays a fundamental role in the mineral world. It never appears alone, but its compounds form 87 per cent of the earth's crust. All kinds of quartz, including sand and flint, are silicon dioxide, or silica. Granite is 20 to 30 per cent silica. Most clays and other soils contain silicates. These are salts in which silica is combined with basic oxides of such metals as aluminum, magnesium, iron, and potassium.

Natural compounds of silicon are important in industrial chemistry and in the manufacture of glass, earthenware, furnace linings, and other heat-resisting materials. Cast iron contains silicon. Silicon steel is valued in the electrical field because of its superior magnetic properties (*see* Alloys). A whole family of synthetics, called the silicones, is built up around the element silicon (*see* Silicones).

When heated at a high temperature with an equal part of carbon, silicon yields silicon carbide. This

compound is near the diamond in hardness. It is widely used for whetstones, grinding wheels, and polishing and abrading powders. Edward G. Acheson, an American inventor, obtained it by accident in 1891 when he was trying to make artificial diamonds. He gave it the name *carborundum*. Carborundum is also highly resistant to heat. Combined with fire clay, it is used as a high-temperature furnace lining.

Silica gel, a colloidal form of silicon dioxide, is widely used as a desiccating (drying) agent. It adsorbs water from the air, changing color as it does so; when saturated it may be heated to drive off the moisture. (*See also* Colloids.)

Silicon has a strong affinity for oxygen. It can be separated (reduced) only by a powerful reducing agent such as magnesium or at a high temperature by carbon. Amorphous silicon, prepared in the laboratory by heating silica with magnesium powder, is a light-brown crystalline powder. Commercial silicon is produced by heating silica and carbon in an electric oven or by heating silica and calcium carbide. It is a gray crystalline mass.

Silicon is in the same group with carbon in the periodic table and it has similar chemical characteristics. Its atoms contain four valence electrons and these form covalent bonds. Silicon yields binary compounds with many metals, a few nonmetals, and with oxygen and hydrogen. Unlike carbon, it forms alloys with metals.

Silicon enters into the composition of many semiprecious stones. Among them are agate, amethyst, aventurine, bloodstone, cairngorm, carnelian, cat's-eye, chalcedony, chrysoprase, jasper, moss agate (mocha stone), onyx, opal, rose quartz, and sardonyx. (*See also* Quartz.)

SILICONES. The synthetic materials called silicones are a cross between inorganic substances, such as glass, and organic substances, such as rubber. Sand supplies their inorganic ingredients—silicon and oxygen. Coal and oil provide their organic ingredients—various hydrocarbons.

The inorganic side of their nature gives these synthetics great stability. They withstand heat and cold, moisture, and dryness. They resist such chemical processes as oxidation and the action of acids. Like glass and quartz, they are electrically nonconducting. Yet, owing to the organic side of their nature, they also have variety, plasticity, and the quality of repelling water.

A Versatile Family of Synthetics

There are more than a hundred silicones. The characteristics of the family have given rise to types for many purposes. A silicone finish for textiles makes them water repellent even after dry cleaning or washing with soap. It keeps them from being badly stained by ink, coffee, and other liquids. Yet the finish is not affected by heat, cold, or sunlight. Silicone polishes for automobiles and furniture give gloss without rubbing. They remain water repellent longer than wax does. Desert heat does not melt them or subzero weather freeze them. A silicone finish on automobiles reduces the adherence of ice, road dirt, and insects.

A quality of the silicones which technologists call the "release property" is the dominant factor in several interesting silicone products. One of these is a glaze for the pans used in commercial bakeries. It eliminates the need of greasing pans to keep bread, cakes, and other bakery products from sticking. The glaze does not smoke or burn at high temperatures.

A similar silicone, called a "mold release agent," is used in factories that make tires, rubber heels and soles, bottle stoppers, and other articles molded of rubber or synthetic plastics. The molds to shape these articles are coated with the release agent before the hot plastic material is poured into them. After they have hardened, the most intricately designed articles slip out of the molds easily, just as bread slips easily out of a silicone-glazed baking pan.

The two factors of stability and nonconductivity have led to a variety of industrial applications. Silicone greases and oils are used where extreme temperatures would melt or freeze ordinary organic types A moisture-proof nonconducting paste which seals aircraft ignition systems and electrical control circuits is unaffected by weather. A silicone varnish or resin is combined with well-known nonconductors such as mica, asbestos, and glass fibers to make insulators that are moisture proof and resist temperatures up to 500° F. They lengthen the life of electric motors, transformers, and generators. They are widely used in Diesel-electric motors. Silicone rubbers are used where there is a great range of temperature; for example, in gaskets, seals, diaphragms, and other parts of aircraft.

Chemistry and Synthesis of Silicones

The silicone molecule has a chainlike skeleton of alternate silicon and oxygen atoms, just as the molecules of many organic synthetics have a chainlike skeleton of linked carbon atoms. But the bond between silicon and oxygen atoms is half again as strong as that between two carbon atoms. The inorganic skeleton of the silicone molecule is built out from the chain with hydrocarbon groups attached through carbon to silicon. The bond between silicon and carbon is strong and relatively heat resistant. The strong bond energy in the silicon-to-oxygen and silicon-to-carbon linkages of silicone molecules gives these synthetics their stability.

It is usually said that the silicones are made of sand, brine, coal, and oil. There are two methods of turning these materials into silicones. Each involves a long series of chemical reactions. In one method a reaction between products from sand and brine produces silicon tetrachloride. Magnesium is then used in the Grignard reaction and the chlorine atoms are replaced by hydrocarbon groups. This process yields organo-silicon chlorides. Hydrolysis and further reactions build up high polymer silicones. The other method, a direct process, starts with the reaction between pure silicon and organic halides with a metal as catalyst. This yields organo-silicon chlorides.

Beautiful SILK—SPUN *by* SILKWORMS

SILK. Of all fabrics, fine silk is the most beautiful. It has a look and a feeling of richness that no other cloth can equal. It is strong and durable. Dyed in rich colors and woven into beautiful designs, it represents luxury in textiles.

Each fine thread, or filament, that goes into silk cloth is spun by a silkworm to make its cocoon. Silkworms are hungry but delicate little animals. They require more than a month of regular feeding under carefully controlled conditions before they begin to spin their cocoons. An average cocoon contains about 600 yards of filament, and this gossamer thread has to be unwound carefully so that it will not break. Enough silk cloth to make a dress may take the filament from 1,700 to 2,000 cocoons. All this means that production of silk requires long hours of patient, painstaking labor on the part of many workers. It can be successful only in places where skillful hand labor is comparatively cheap. The Orient has long been the chief home of silk culture. Today Japan produces about 65 per cent of the world's supply of silk, Russia 12 per cent, and Italy 8 per cent.

Here is the source of silk—*Bombyx mori* as moth, caterpillar, and cocoons, together with mulberry leaves.

The "Worm" Is a Caterpillar

The silkworm is really a caterpillar, the larval stage of a moth. There are many kinds of silk moths. They flourish almost everywhere in the world except where it is extremely hot or extremely cold. But the quality of the silk spun by different species varies greatly. The most important of all the silk moths, the one which supplies most of the world's silk, is *Bombyx mori.* This moth feeds chiefly on the leaves of the white mulberry tree.

People have raised *Bombyx mori* for its silk for more than 3,600 years. In this long period the moth has almost lost its ability to fly. It exists today only where it is raised for its silk.

How Silkworms Produce Silk

THE BUSINESS of raising silkworms and unwinding their cocoons is known as silk culture or *sericulture.* The principles are the same everywhere, but details vary in different countries. Since Japan produces the most silk, methods in use there will be described.

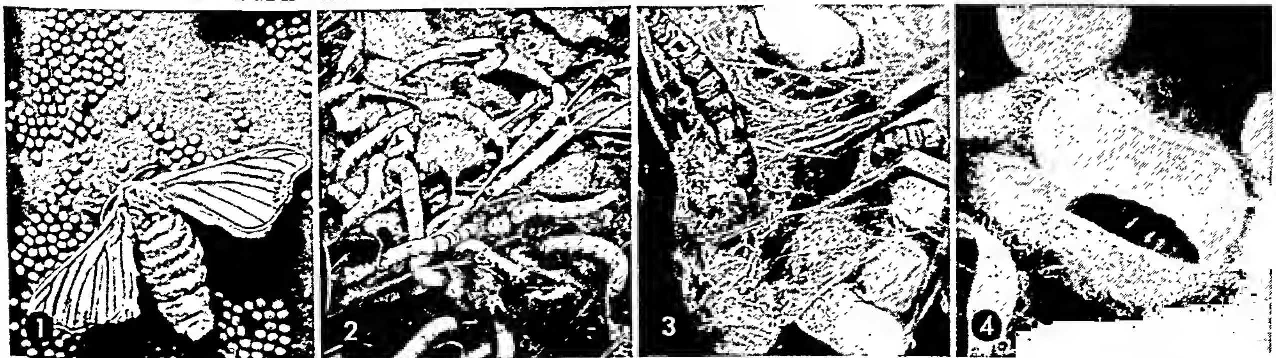
Japanese silkworms begin life in institutions licensed by the government to raise and sell silkworm eggs. These establishments guarantee to sell only healthy eggs. They raise and breed moths in hospitallike surroundings. Microscopic examination of moths insures sound eggs.

Mother moths each lay about 400 tiny eggs on especially prepared cards. The natural hatching period is nine months. But workers soak the eggs in a chemical solution and store them at temperatures near freezing to control hatching. One third of the spring crop is ready to hatch in May or June, one third later in the summer, and one third in the fall.

Silkworms are reared chiefly on small farms in hilly regions. The farmer grows rice on the low, wet part of his land and mulberry trees on the higher, drier part. The entire family helps care for the silkworms.

The farmer buys silkworm eggs from a local "egg station." This is a branch of an egg-raising estab-

THE LIFE CYCLE OF THE SILKWORM MOTH



These pictures show various stages in the life of a silkworm: 1. The mother moth has laid her hundreds of eggs, each no bigger than a pinhead. 2. These caterpillars are about 30 days old and still eating. 3. The silkworms shown here are all spinning. 4. These cocoons have been opened to show the pupa, or chrysalis, inside. If left undisturbed, the pupa would become a moth.

A PICTURESQUE JAPANESE SILK FARM

The silkworm reigns supreme in this farmhouse, where the farmer and his family raise the "worms" from egg to cocoon. The little boy is displaying a basket of cocoons that are ready for market. The big trays in the foreground, made of bamboo and straw, are used for feeding.

lishment. He may buy an ounce—30,000 to 40,000 eggs. He usually takes them to an incubator in the village, where hatching requires about ten days. Newly hatched grubs (called "ants") are one eighth to three eighths of an inch long and about as big around as a human hair. The farmer carries his thousands of "ants" home and spreads them on trays made of bamboo and straw. He places the trays on bamboo shelves built around the rooms of his farmhouse.

The "ants" have voracious appetites. The farmer and his family feed them sliced mulberry leaves five or six times a day and two or three times during the night. The tiny grubs may eat three or four times their weight in leaves during the first 24 hours.

Silkworms need good care, for they are quite likely to become diseased. The room temperature has to be kept at 75° to 80° F. Protection against drafts, smoke, odors, and noise is necessary. The room must be kept light, but the sun must not shine directly on the silkworms. The mulberry leaves should be approximately the same age as the grubs—tender young leaves for newly hatched "ants" and mature leaves for older caterpillars. The leaves must be clean and dry, but not dried out.

Cleanliness is essential. As a rule the farmer stretches a clean net over each tray once a day. He spreads mulberry leaves on the net. The caterpillars crawl up through the net to feed. The farmer then transfers net, leaves, and caterpillars to a clean tray and removes the soiled tray for cleaning.

The caterpillars hatched from the farmer's ounce of eggs eat more than 1,500 pounds of mulberry leaves in the month of their existence as caterpillars. Every member of the farmer's family is kept busy picking leaves. Trays of caterpillars and piles of leaves almost fill the small farmhouse. The caterpillars' eating makes a soft noise in the rooms like the falling of light rain on leaves.

Silkworms shed their skins, or molt, four times before they are full grown. Plump, grayish-white, mature caterpillars measure 3 to $3\frac{1}{2}$ inches long. During the last two or three days of their life as caterpillars they eat more heartily than ever. The reason is that in this period they secrete most of the substance from which they will make their cocoons.

Finally, after about 32 days, the caterpillars stop eating and lift up their heads. The farmer knows they are ready to spin. He transfers them to trays containing piles of straw or many-celled straw racks. Here they construct the cocoons which protect them during their metamorphosis from caterpillars, through the pupal stage, into moths. (*See also* Butterflies and Moths; Caterpillars.)

How the Silkworm "Spins"

Each caterpillar has two glands in its head which secrete a thick fluid that is to become silk. Two

A HEARTY MEAL FOR SILKWORMS

Here a member of the farmer's family is arranging a feeding of mulberry leaves for partly grown caterpillars. The feeding trays slide onto the shelves arranged around the wall.

other glands secrete sericin (*sĕr'ĭ-sĭn*), a kind of glue. Ducts connect all these glands with a tiny opening known as the spinning head or spinneret. This is located under the caterpillar's lower jaw.

The caterpillar attaches itself to straw on the cocoon tray by a preliminary squirting of fluid. Then it doubles back on itself, with its legs to the outside, and begins to "spin." Contractions of its body force substance from the two silk glands, together with sericin, through the spinneret. Contact with air hardens the two streams of silk fluid, and sericin makes them stick together as one strand. With a figure-of-eight motion of its head the caterpillar winds this filament around and around itself until it is completely enclosed.

Spinning lasts three days. The caterpillar shrivels and shrinks in the process until it is only 1¼ inches long. Metamorphosis requires approximately two weeks. The farmer has to collect and sell the cocoons during this period.

The farmer's ounce of eggs yields about 100 pounds of cocoons. He sells these direct to a silk company or at a nearby cocoon market. Most of the markets in Japan are buildings where cocoons can be inspected quickly and sold at auction. The buyers represent filatures, or silk-reeling plants.

After the farmer sells his cocoons, he returns home to fumigate his house. He and his family may have it to themselves for a few months, or they may immediately begin raising another batch of silkworms.

Unwinding the Cocoons

If a filature operates an egg-raising establishment, workers select some of the best cocoons for breeding. They place the rest on belts which move slowly through a hot-air chamber. The heat kills the pupas and dries out the cocoons.

Dried cocoons are soaked in hot water until they are soggy and have lost some of their sericin. They are brushed while under water to remove loose broken silk (floss) and dirt. Then they are distributed to "reeling girls."

Each reeling girl stands or sits in front of a basin filled with warm water. Behind the basin is an apparatus topped by spool-like reels. Steam or electricity turns the wheels of this apparatus, but its successful operation depends on the girl's skill in handling cocoons.

The reeling girl places her supply of cocoons in the basin and finds the loose ends of several filaments, usually five. She twists these together, threads them through an "eye" in the reeling machine, carries them up over two small wheels, and fastens them to a reel. When the reel turns it draws the filaments up and winds them in one lightly twisted strand. The cocoons bob up and down in the water as they

COCOONS—FROM FARM TO MARKET

All the trays shown above hold caterpillars spinning their cocoons. Each tray supports a framework of folded straw. The caterpillars have found places on the frames to attach themselves in order to spin.

These women are picking fully spun cocoons out of the straw frames. They have to be careful not to damage the cocoons. Each framework can be folded as it is emptied of cocoons.

This picture shows a silk market at Mayebashi, Japan, with a cocoon-selling section in the foreground. It is said that the silk markets of Japan are something like the tobacco auctions of the United States.

THE DIFFICULT PROCESS OF REELING SILK

The girls shown above are reeling silk filaments from cocoons in the basin. The smoothness of the silk strands depends on their skill in twisting in new filaments when the ones being unwound break off or run out. The woman in the picture at the right is rereeling the silk in uniform lengths for skeins.

unwind. Each girl has charge of about five reels. She always holds in her hands the free ends of filaments from several cocoons. If a cocoon stops bobbing in the water she knows a filament has broken or run out. In its place she twists in one of those she is holding. Sericin, which still clings to the filaments, makes the joining hold.

A second reeling follows. Its purpose is to measure off the silk into uniform lengths. The strands are wound from the original reels onto a second set, which stop turning after about 400 revolutions. Workers then inspect the silk, remove it from the reels, and twist it into skeins. It is now *raw silk.*

RAW SILK READY FOR SHIPMENT

Here are skeins of silk being packed into "books" and "bales." Each book (in the foreground) contains 30 skeins, and each bale (in the background) contains 28 or 30 books.

From Raw Silk to Silk Cloth

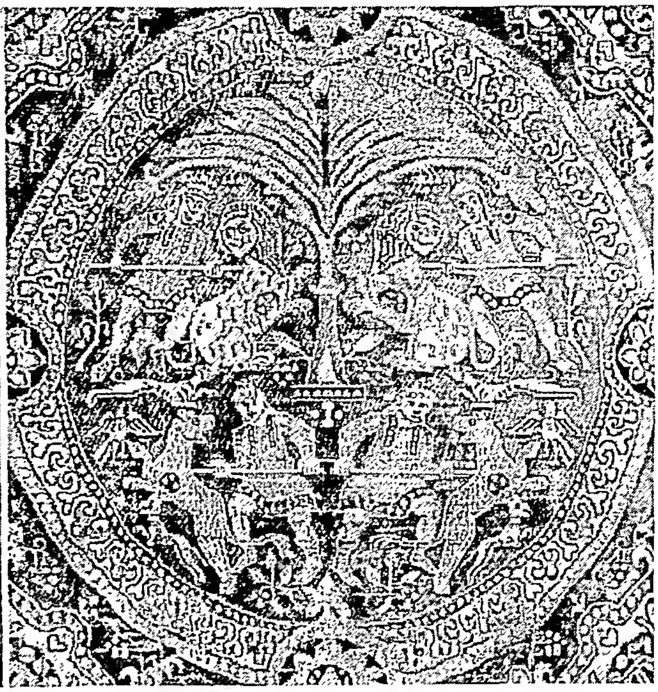
RAW SILK needs cleaning and twisting into heavier strands before it can be woven into cloth The twisting is known as *throwing*, and the people who do it are *throwsters*. The process is highly mechanized. Most of the silk used in the United States is imported as raw silk. It is thrown and woven in this country. Centers of the silk industry are Paterson, N. J., and Allentown, Pa.

Workers in throwing mills soak the skeins of raw silk to soften the remaining sericin. Then they straighten out the skeins, dry them, and put them on reels. A machine quickly winds off the strands onto big spools called bobbins.

Throwing machines contain hundreds of spindles and bobbins. They look like cotton-spinning frames (*see* Textiles). On these machines, throwsters combine two or more single strands, known as *singles*, into one yarn with varying amounts of twist. The throwing process which combines strands is called *doubling* Two or more singles twisted lightly together make *trams*. This yarn is used to make the weft of cloth. Two or more well-twisted singles twisted firmly together in the opposite direction from the original twist make *organzine*, which is used as warp.

Thrown silk still contains sericin. Workers remove this gummy substance either before or after the yarn is dyed. Removal of sericin does not affect the length or strength of silk yarns. It does, however, reduce their weight.

BEAUTIFUL SILKS FROM FAMOUS MUSEUMS



The Chinese silk at the left above is in the Metropolitan Museum of Art, New York City. The old-blue satin panel is embroidered in pastel silks. At the right is a treasure of the Vatican—Persian silk of the 8th century with a lion hunt in a roundel motif.

The methods used in dyeing yarn, weaving cloth, and printing fabrics are in general the same for silk as for other kinds of cloth. (*See also* Spinning and Weaving; Fabrics; Textiles; Dyes.)

Weighted Silk, Spun Silk, and Wild Silk

Weighted silk has been passed through a solution of metallic salts. The salts combine with the silk and add to its weight. Weighted silk has a better luster than unweighted silk and drapes better, but it is less durable. A 1938 ruling by the United States Federal Trade Commission requires that the terms silk, pure silk, all silk, and pure-dye silk shall indicate that a fabric is made only of silk. They cannot be applied to cloth containing any substance other than silk except dyeing and finishing materials. Finishing materials shall not constitute more than 15 per cent by weight of black silk or more than 10 per cent by weight of white or colored silk. Weighted silk must bear a label showing the amount of weighting and finishing material over and above these percentages.

Spun silk is made from floss and other waste filaments. These fibers are carded and spun into yarn by methods similar to those used in spinning wool. Most cloth made from spun silk is not lustrous and is likely to become fuzzy.

Wild silk comes from various kinds of undomesticated silkworms. The best-known wild silk is *tussah,* supplied chiefly by two jungle moths: *Antherea mylitta* of India and *Antherea pernyi* of China. The filaments are coarse, dark, and irregular compared to those of *Bombyx mori.* They do not unreel freely, and as a result are used chiefly as spun silk. The yarns go into pongee, shantung, rajah, and similar fabrics. The cocoons are yellowish, tan, or light brown, and the fabric is often made up in this natural color.

SILK TO WRAP PRESENTS

This Japanese tapestry of the late 18th century was originally a wrapper for gifts made of tapestry-woven brocade. It is owned now by the Metropolitan Museum of Art in New York City.

History of Silk

LEGEND says that a 14-year-old empress of China named Si-Lin-Shi discovered the usefulness of silkworm cocoons about 2640 B.C. There were many mulberry trees in her palace gardens. She must often have watched silkworm caterpillars feeding on their leaves and then spinning cocoons. One day she carried a cocoon into the

palace. A few days later, after the moth had emerged, she accidentally dropped the cocoon into a basin of hot water. The water softened the cocoon and she was able to unwind the long filament. She realized that a few such filaments twisted together would make a yarn strong enough for weaving.

Si-Ling-Shi's husband was Huang-Ti, the third emperor of China. With his encouragement, Si-Ling-Shi had a rearing shed built on the palace grounds. The ladies of the court helped her raise silkworms and make yarn from the cocoons. Si-Ling-Shi, it is said, invented a reeling device. Soon she had enough silk yarn to weave a robe for her husband.

For more than a thousand years only the Chinese royal family and the nobility were allowed to wear silk. Si-Ling-Shi was deified as the goddess of silk, and the court held a festival in her honor every spring. Serfs attached to the imperial court reared silkworms and made silk cloth.

The privilege of wearing silk was extended to local rulers and petty officials about 1200 B.C. Presently silk cloth was put up for sale in public markets. The silk serfs were exploited by silk merchants, and some of them fled to Korea and northwestern China. Trade in silk cloth developed with Persia and later via Persia with Greece. During the Han dynasty (206 B.C.–A.D. 220), caravans carried Chinese silks to India, Turkestan, and Persia.

Silk Culture Outside of China

Two Korean princes taught silk culture to the Japanese in the 3d century A.D. in return for military help against a local uprising. The Japanese imperial family fostered the new craft. It had become an important part of Japanese life by A.D. 600.

The people of India had fabrics of wild silk as early as 1400 B.C. Cultivation of silkworms is thought to have spread into India from northwestern China about 400 B.C. By the 2d century A.D. India was shipping raw silk and silk cloth to Persia in competition with China's overland commerce.

Persia became a center of silk trade between the East and the West under the Parthians (274 B.C.–A.D. 226). Silk dyeing and weaving developed as crafts in Syria, Egypt, Greece, and Rome. The workers used some raw silk from the Orient, but they got most of their yarn by unraveling silk fabrics from the East. Silk culture remained a secret of the Orient.

Silk cloth was literally worth its weight in gold in the Roman Empire. Eventually a strong demand for the local production of raw silk arose. Justinian I, Byzantine emperor from 527 to 565, persuaded two Persian monks to go to China to study silk culture. These monks secretly mastered all the crafts concerned in producing raw silk. Then they returned to Constantinople bringing with them a supply of silkworm eggs in their hollow bamboo walking sticks. Justinian established silk culture in Constantinople, and it gradually spread to other parts of the empire. Early centers were Athens, Thebes, Corinth, and Argos.

Silk culture flourished in Europe for many centuries (*see* Textiles). But in 1854 a devastating silkworm plague appeared. Louis Pasteur, asked to study the disease in 1865, discovered the cause and means of control. The Italian industry recovered, but that of France never did. Meanwhile Japan was modernizing its methods of sericulture. Soon it was supplying a large portion of the world's raw silk.

SILO. Storing green crops in a silo is like bottling up a pasture. Nearly every well-equipped farm has one or more of these tall cylindrical structures in which to store up fresh juicy foods for the stock, much as fresh fruits and vegetables are canned for human use. Dried grains and fodder unmixed with green foods are not only expensive for feeding stock, but are so unsatisfactory for milk cows that it used to be common practise to allow them to go dry during the winter. The ensilage, or silage, as the food stored in the silo is called, rivals the pastures of June in providing the succulent and vitamin-rich foods so necessary for the dairy herd as well as other farm stock. It is especially useful in promoting the healthy growth of young animals.

Corn, which is the principal silage crop, is cut before the juices of the green plants begin to dry out in the fall. The entire plant—stalk, leaves, and ears—is chopped into short lengths by machinery so that it will pack readily, and put directly into the silo. If the corn is too dry, water is poured over it as it is packed away. It is estimated that food equivalent to four tons of hay can be produced ordinarily from one acre of corn. This makes corn preserved in a silo a very economical crop, especially as it is so compactly and economically stored. Where corn cannot thrive, sunflowers are sometimes grown for silage. Clover, oats, rye, sorghum, alfalfa, cow peas, beans, millet, and wheat may also be used as silage when cut green.

Inside the silo, the green moist fodder turns mildly sour, after which it is known as silage. The acids produced by this fermentation check the growth of the organisms that would otherwise cause the silage to decay. Thus, pickled in its own juices, it will remain in good condition for many months.

The silo, which has brought about some of the most important changes in modern agriculture, was introduced into America from Europe about 1875. The first silos were pits dug in the ground into which the crops were packed and covered over with straw and sod. Many silos today are covered trenches or pits lined with masonry. A silo built above ground is usually a tower of wood, masonry, or metal, which is waterproof, verminproof, and shut off from the outside air. Nearly all of them are cylindrical, so there can be no corners where air spaces may cause spoilage. Also their slender shape leaves as little silage as possible exposed at the top surface. Usually the silage from the top is used first. It is taken out through doors in the side of the silo.

SILVER. Late in the spring of 1859 two grizzled miners were busy with pickax and shovel in the barren wilderness near where Virginia City, Nev., stands today. They were digging a reservoir to collect water for their crude mining operations. For months

STEPS IN THE MAKING OF SILVERWARE

1. Here are shown the successive stages in the manufacture of a silver bowl. It is shaped on those wood forms or "chucks" while spinning in a lathe. 2. A workman demonstrates the process of spinning. With a blunt instrument he presses upon that revolving silver disk to give it the form of the chuck on which it is mounted. 3. With hammer and punch, an expert is producing a delicate design on a valuable silver trophy. This process is called "chasing." 4. A teaspoon begins as a pattern drawn by an industrial designer. 5. From this pattern the spoon is carefully modeled in wax. 6. Then the design is cut sharply into a block of die steel. Another die (not shown) is cut for the back of the spoon handle. 7. A spoon is about to be stamped between the two dies, which will strike the designs simultaneously on front and back.

the gold dust they had been able to wash from the near-by gravel banks had scarcely provided a living.

At a depth of four feet one of the miners felt his pickax strike a hard substance, a heavy black dirt very different from the surrounding yellowish gravel and clay. Completely ignorant of the nature of the substance, they washed it in their "rockers." They were disappointed to find, instead of fine yellow gold, a much lighter-colored metal, barely tinged with a golden hue. Not long afterward they sold their discovery for a small sum, little realizing that it was one of the richest bodies of silver ore ever unearthed. In 30 years the little strip of ground, known as the Comstock Lode for one of its discoverers, produced more than 300 million dollars' worth of silver and gold. This tremendous production cheapened silver and upset the money standards of the whole world.

Age-old History and Modern Production

Silver has been known and used by man since prehistoric times. It is mentioned in the Chinese classics, dating from 2500 B.C. Herodotus, the Greek historian, says: "So far as we know the Lydians were the first to make coins of gold and silver." The silver mines of Laurium, in Attica, are famous in Greek history; and those which Carthage exploited later in Spain are even better known. Roman envy of this wealth helped bring on the Punic Wars.

Since the discovery of America in 1492, about 15 billion ounces of silver have been mined throughout the world. This is 15 times the production of gold in the same period. The Americas have produced 85 per cent of the total, and North America alone has produced 60 per cent. Mexico is far in the lead, with the United States and Canada next in order. In the United States the greatest output has come from Idaho, Utah, Montana, Nevada, Colorado, and Arizona. (*See* Mines and Mining.)

Monetary and Industrial Uses

About three-fourths of the world's production of silver is used for monetary purposes, either as coins or as bullion which governments hold to redeem paper currency. Many oriental countries, most notably China and India, use silver as a standard of monetary value (*see* Money).

The leading industrial use is for the manufacture of tableware and jewelry. The photographic industry is the second largest industrial consumer. Compounded with bromine or chlorine, silver forms the salts which register light and shade on films, plates, and photographic prints (*see* Photography).

Silver is an important substitute for copper, nickel, aluminum, and tin when these cheaper metals are unavailable. It can replace tin in common solders; a standard formula is 95 per cent lead or cadmium and 5 per cent silver. It can replace copper in certain parts of electrical equipment. Silver-plated bearings in airplanes and other machines surpass all other types for satisfactory service.

Because silver is highly resistant to organic acids and alkalies, many items of chemical and food-manufacturing equipment are silver lined. *Silver nitrate* or "lunar caustic," made by dissolving the metal in nitric acid, is a powerful antiseptic. It is used to treat eye and throat infections and for certain gastric and intestinal diseases. As a bactericide it is used to sterilize drinking water and swimming pools, and in certain mouth washes, soaps, and salves. Silver nitrate is also used for making mirrors (*see* Mirrors). *Silver fulminate*, made by adding alcohol to a solution of silver nitrate in nitric acid, is a dangerously sensitive explosive.

"Sterling" and Other Standards of Fineness

Pure silver is too soft to stand constant wear; hence for most uses it is alloyed with some other metal. Silversmiths use silver .999 fine—that is, 999 parts of silver to one of another metal. This fineness is also used for monetary reserves; but United States silver coins contain only 90 per cent silver, alloyed with 10 per cent copper.

Sterling silver, used in jewelry and tableware, is 92.5 per cent silver and 7.5 per cent copper. Plated silverware is a coating of silver electroplated on a base metal such as nickel silver, britannia metal, copper, or brass (*see* Electricity; Electroplating).

Chemical and Physical Properties

Silver is a lustrous white metal, widely distributed in nature. In ores it is commonly associated with gold, lead, and copper, and much of our silver is obtained as a by-product of smelting these other metals. It is one of the chemical elements; its chemical symbol Ag is from the Latin "argentum" for silver (*see* Chemistry).

Silver is second only to gold for malleability and ductility. Silver leaf can be beaten to a thickness of 1/100,000 of an inch and one ounce can be drawn out into a wire 30 miles long. As a conductor of heat and electricity, silver is superior to all other metals. It melts at 1,761° F., and boils at 3,542° F. At this temperature it volatilizes, or forms a pale blue vapor which can absorb 20 times its volume of oxygen. As the vapor cools to a solid, it expels the oxygen with great violence—a phenomenon known as "spitting silver." It resists corrosion, but combines readily with sulphur. The black tarnish on silverware is silver sulphide, which is commonly formed by the sulphur in eggs.

The Silver Purchase Acts

The "New Deal" Silver Purchase Acts of 1934 and 1939 authorized the Treasury to buy silver until one-fourth of the value of the combined silver and gold monetary stock was represented by silver, or until the world market price reached $1.29. But the market price never reached this figure; and since the government was buying gold freely at this time the 25-75 ratio of silver to gold was never realized. By paying a high price the Treasury accumulated a hoard of 3 billion ounces, or one-fifth of the world's production since the discovery of America, in its vaults at West Point, N.Y.

In 1946 Congress set the price of silver at 90.5 cents an ounce. It authorized the Treasury to sell stocks not needed for coinage or as backing for currency. Demand for silver was heavy because silverware manufacture had been restricted during the second World War, and other industries had increased their use of the metal during the war.

SIMS, REAR ADMIRAL WILLIAM SOWDEN (1858–1936). Few naval officers have had as stormy a career as this outspoken fighter. He created more than one international incident, was publicly reprimanded by a president, and several times barely escaped court-martial. Yet when the United States went to war in 1917, Sims led the navy in action.

Sims was born of American parents in Port Hope, Canada, Oct. 15, 1858, and was educated at Annapolis, 1876–80. He first won fame as a lieutenant on duty in China in 1902. There he went over the heads of his superiors and charged directly to President Theodore Roosevelt that American naval gunnery was hopelessly inaccurate. President Roosevelt called him home and put him in charge of gunnery practise. He spent seven years at the job, and he became known as "the man who taught the navy how to shoot."

In 1910 Sims spoke in London, and told the British that "blood is thicker than water," and they could count on America's complete support if they were ever "menaced by an external enemy." President Taft sharply and formally reprimanded him for this speech. But in April 1917, Sims, then head of the Naval War College, was placed in charge of American naval forces in Europe. He held this post until the end of the war.

SINGAPORE (*sĭng-gȧ-pōr′*). The island and city of Singapore are just a tiny dot on the map; but they form a "key to the East Indies." They lie off the tip of the Malay Peninsula, facing the Strait of Malacca between the Indian Ocean and the Pacific. The strait provides the most convenient route between Europe and the Republic of Indonesia, China, and Japan Hence any power that owns Singapore can dominate this rich trade route.

The harbor on Singapore Strait is filled with an amazing assortment of vessels. Ocean liners and island freighters mingle with Malay proas and Chinese junks. The city is the world shipping center for rubber and tin. It also provides rich cargoes of spices and other oriental commodities.

The town of Singapore stands almost on the Equator. The temperature seldom falls below 70° F., and it rains nearly half the days of the year. Singapore is one of the most cosmopolitan cities in all the world. Although three fourths of the people are Chinese, almost every other nationality is represented in its narrow streets.

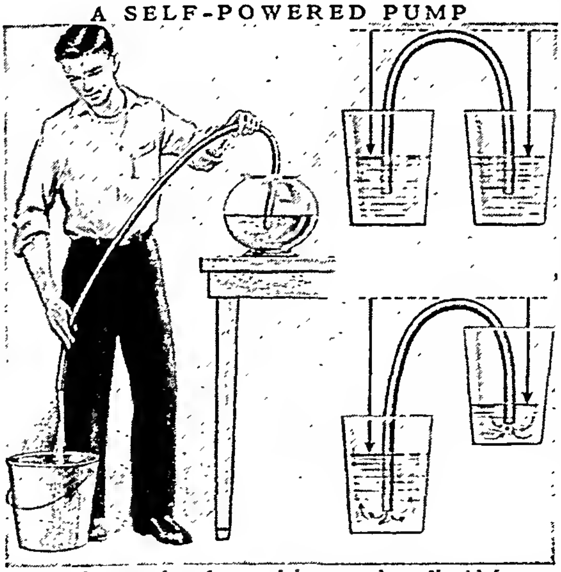
The whole island of Singapore is 26 miles long and 14 miles wide, with an area of 220 square miles. The British acquired the island from the Sultan of Johore in 1819. At that time it was virtually an uninhabited swampland. The British soon made it a great seaport. In 1922 they began to fortify the island on a grand scale. But the British made the mistake of fortifying only against attack from the sea. Early in the second World War, on Jan. 31, 1941, the Japanese stormed the fortress from the rear by advancing upon it through the jungles and swamps of the Malayan mainland. On Feb. 15, 1942, after a short siege, Singapore surrendered to the Japanese. It was restored to the British in September 1945. (*See also* Malay Peninsula.)

Before the second World War, Singapore was the seat of government for the Straits Settlements, a British colony. In 1946 Britain made Singapore a separate colony. The colony includes the dependency of Christmas Island in the Indian Ocean. Population of Singapore island (1947 census), 940,824; of town, 679,659.

SIPHON. Can you drain water out of a glass without tipping it? You can do it easily with a siphon. Fill a rubber tube with water, and pinch the ends to keep the water in. Put one end in a vessel of water on the table and the other in an empty bucket on the floor. Release the ends, and the water flows from the upper vessel to the lower one.

The water flows *up* the short column of the tube because the weights of water in the two columns are different. The upper right drawing shows what happens when the two columns are of equal weight. The water tends to fall out of each column, but does not because the surrounding air exerts pressure on the water around each end of the tube and holds the water up.

A SELF-POWERED PUMP



These pictures show how a siphon can draw liquid from a vessel up and through a tube. Left, an experimenter has set up a siphon, as explained in the text. The upper right drawing shows how the liquid remains static if the columns of the tube are the same height. The lower drawing shows how the liquid is pulled from the upper to the lower glass by the difference in weight between the long and short columns of water.

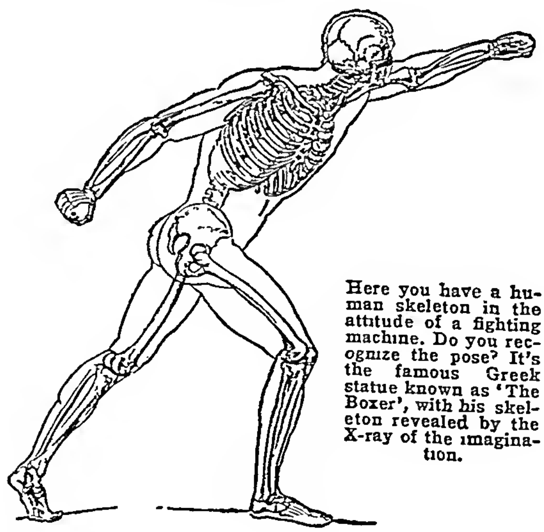
In the lower drawing, one column of the tube has been lengthened. Now there is more water in this column than in the other. But the atmospheric pressure has not been increased enough to support the extra weight, so the water starts falling. As it does, water is forced up the short column to replace it, and to prevent a vacuum forming at the bend. Actually this whole process takes place immediately, and the long end need not be immersed. The flow continues until the upper glass is empty. A siphon will not raise water in the short column more than about 33 feet at sea level. Above that height, the weight of the water more than equals atmospheric pressure. The siphon principle is applied in pipes that carry water from an aqueduct across a valley, and in various industrial piping uses.

SISAL (*sī′săl*). Binder twine, cord, and some rope are made from the fibrous leaves of two species of the agave plant. Both species are commonly called sisal. One is the true sisal (*Agave sisalana*), and the other is henequen (*Agave fourcroydes*), also called Mexican or Yucatan sisal. Both originated in the Yucatan peninsula. They are cultivated on large plantations in the tropics. East Africa, Java, and Sumatra are the principal sources of true sisal today. Yucatan still produces most of the world's supply of henequen, which is somewhat inferior in quality to sisal.

Sisal and henequen, like their relative the century plant (*see* Agave), bloom only once and die after flowering. The plants normally mature in from five to ten years, but their life may be prolonged by cutting a certain proportion of the leaves each year. The swordlike leaves are from 30 to 60 inches long and 4 or 5 inches wide, ending in a sharp spine. They spring up straight and stiff from a central bud.

The leaves are cut by hand, one at a time, and the terminal spine and marginal prickles trimmed off. One man, with an assistant to trim and bundle, can cut from 3,000 to 5,000 leaves in a day. Plantation railways transport the bundles directly to a central mill, where machines beat and scrape the pulp from the fiber. The fibers are then dried in the sun or in drying machines, and are sorted into grades according to length and quality. As fibers for making cordage, sisal and henequen rank next to Manila hemp in strength. The name "sisal" comes from the name of the Yucatan port from which this fiber was first shipped.

THE MARVELOUS FRAMEWORK OF THE BODY



Here you have a human skeleton in the attitude of a fighting machine. Do you recognize the pose? It's the famous Greek statue known as 'The Boxer', with his skeleton revealed by the X-ray of the imagination.

SISYPHUS (*sĭs′ĭ-fŭs*). In the dark underworld of Tartarus Sisyphus pushes a rock up a steep hill. Just before the rock reaches the top it plunges back again, and so his wearying task is never ended. Sisyphus was the mythical king of Corinth, called the "most crafty of men." He was condemned to eternal punishment because, according to Greek legend, he had outwitted even Death with his trickery. Dante, in his great poem the 'Inferno', and Homer, in the 'Odyssey', describe the labors of Sisyphus.

SKATES AND RAYS. On the bottom of the sea, in shallow coastal waters, live the skates and rays. Their broad, flat bodies are well adapted for this mode of life, and their coloration, blending with the sea floor, keeps them from being noticed by their enemies. The wide, flattened pectoral fins, attached to the body and head, give the fish its peculiar triangular, diamond, or disk shape. In general, the skates are thick-tailed, the rays whip-tailed.

Skates and rays are naturally sluggish, but in pursuit of food they move rapidly by flapping their broad fins. They seize their prey—small fish and crustaceans—by pouncing on top and folding their bodies over the victim. In most species the mouth is a narrow slit on the under side of the head. The breathing mechanism is nicely adapted to life on the ocean floor. When the fish is resting on the bottom, it cannot inhale through the gills on the under side of the head without getting sand in the delicate filaments. It therefore inhales through two spiracles, or breathing holes, on the top of the head, and exhales only through the gills. When in motion it breathes in the usual manner through the gills.

Skates and rays lay their eggs in oblong leathery cases, with a streamer at each corner. The cases are known as mermaids' purses.

The skates and rays range in size from the common skate, 18 inches long, to the manta or devil-fish, measuring 20 to 25 feet wide and weighing over half a ton. On the Atlantic coast of North America the best-known species of skates are the common or little skate, and the larger barndoor, winter, or peck-nosed skate, four or five feet long. On the Pacific coast are the common and big skates of California.

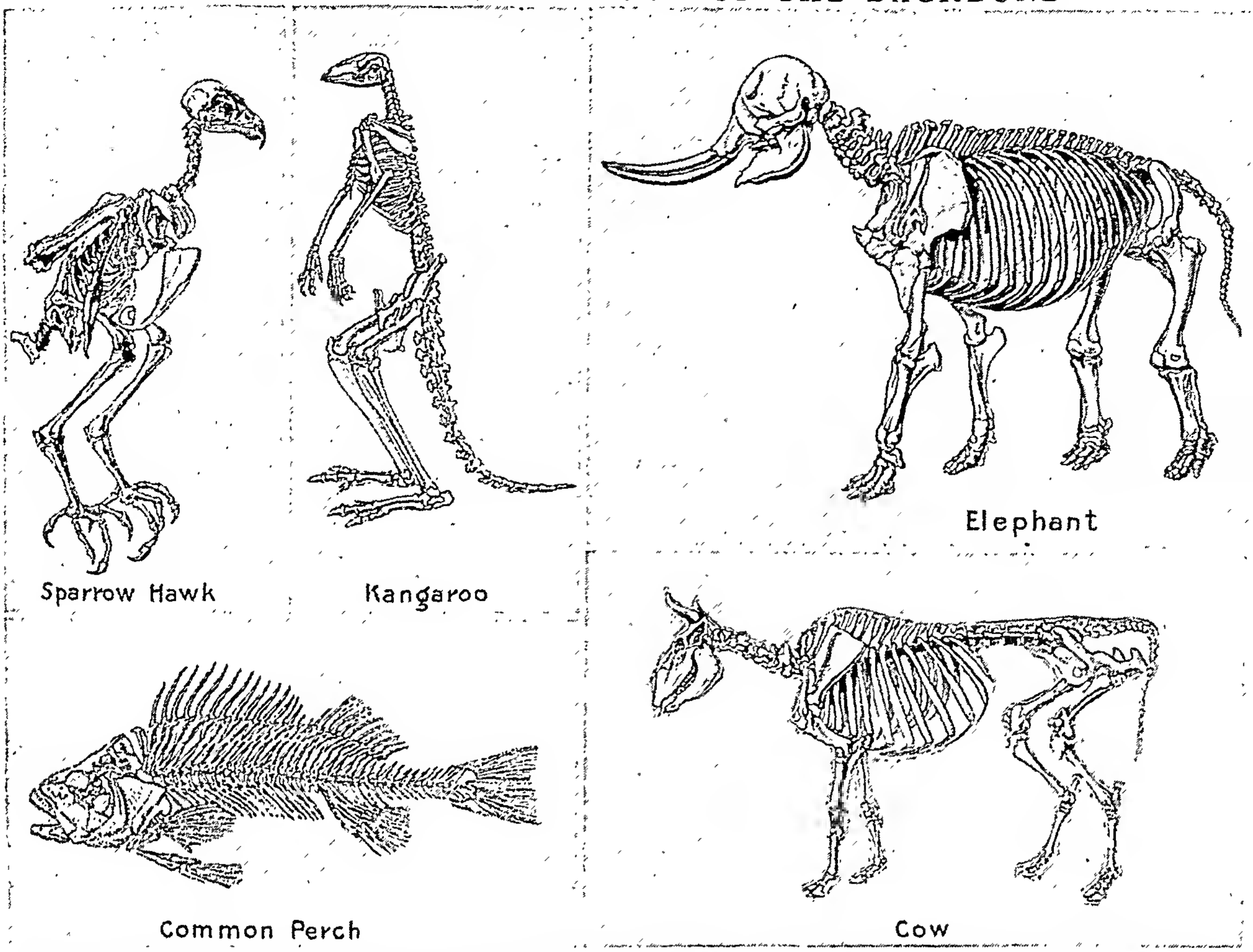
The sting-rays have long, slender tails armed with poisonous barbs, and can inflict dangerous wounds. These rays are common in the warm waters off the Florida, California, and Gulf coasts, and from the West Indies to Brazil. The eagle rays range from Cape Cod to Brazil and from northern California to Panama. The largest of all the rays is the manta, also called the devil-fish, devil-ray, and sea-devil. It frequents warm waters and differs from the majority of the rays in living more in the open sea.

Scientific name of common or little skate, *Raja erinacea;* barndoor, winter, or peck-nosed skate, *R. laevis;* common skate of California, *R. inornata;* big skate of California, *R. binoculata;* sting-rays, family *Dasyatidae;* eagle rays, family *Aetobatidae;* manta or devil-fish, family *Mobulidae*.

Skates and rays are closely related to the sharks. Electric rays, or torpedo-fish, and the sawfish are species of rays (*see* Sawfish; Sharks; Torpedo-Fish).

SKEL′ETON. The bones of the body form a framework called the skeleton. This framework supports and protects the softer tissues. All the higher animals have an internal skeleton (*endoskeleton*) with a central spine or backbone. Many lower animals, such as insects and shellfish, carry their skeletons on the outside (*exoskeleton*). Other creatures of very simple construction have no skeleton. The jelly-fish, squid, and octopus, for example, are supported primarily by the water in which they live.

THE GREAT BROTHERHOOD OF THE BACKBONE



"Nature," says Emerson, "plays one tune to infinite variations." Here we see illustrations of the many "tunes" that she has played on the idea of the backbone. To the backbone of the Sparrow Hawk she attached wings and so made a bird of the air. In the picture of the Kangaroo, note the relative size of the front and hind legs. Even if we had never seen a Kangaroo, the skeleton would tell us that it did not walk on all fours. The Elephant and the Cow have a somewhat similar anatomy, since they are both mammals, and a similar cumbrous dragging gait since neither is a hunter. But the Perch might say: "We fish are the grandfathers of them all"; for Nature's great discovery of the backbone was made in the life of the water.

The normal human skeleton is built of 206 bones. Whether as a framework for the attachment of muscles or as a protection for delicate organs, each bone is shaped with exactness and precision. Some bones are knit solidly together, others are loosely connected, each designed to meet its particular needs.

The movable appendages are hung on a central post known as the axial skeleton. This, with the vertebral column for a nucleus, consists of the bones of the head, neck, and trunk.

In infancy the spine is made up of 33 irregular bones called vertebrae. Early in life the nine bones at the lower end of the column are welded into two, the upper five uniting to form the sacrum, and the remaining four the coccyx. So during the greater part of life we have 24 vertebrae (seven cervical, in the neck; 12 thoracic, that carry the ribs; five lumbar, in the region of the loins), one sacrum, and one coccyx.

Each vertebra is constructed like a ring. These rings, piled one upon the other with a padding of cartilage between, are studded with bony projections called processes and serve for the attachment of muscles and for articulation with other bones. The spinal canal, which is the hollow inside the backbone, contains the spinal cord, and between each pair of vertebrae are openings through which the spinal nerves pass.

If our vertebral columns were straight pillars we would be jarred into nervous wrecks. To prevent injury to the spinal cord and brain, nature has built it like a shock absorber with four curves, giving a slight S-shape, that act as springs.

Jointed to the thoracic vertebrae are 12 pairs of ribs, but only the upper seven of these fit into the breastbone in front. Three of the remaining five pairs are attached by cartilage, but the last two are unattached. The breastbone itself, or sternum, situated in the midline of the chest wall, is a flat bone shaped like a blade. Sternum, ribs, and 12 vertebrae make up the framework of the thoracic cavity.

Whatever the length of the neck, it is always composed of the seven cervical vertebrae. The upper two are the atlas and axis. Atlas supports the head and

rotates with it on a pivot-like process (the *odontoid process*) of the axis.

The skull is composed of cranial and facial bones. Eight bones unite to inclose the brain with a strong box or cranium and to form sockets for the eyes and ears. Its back and base is the occipital bone, perforated by the *foramen magnum*, a passage for the spinal cord. Two parietal bones form the roof and the principal part of the sides; below each parietal bone is one of the temporal bones, which contain sockets for the ears, and bear the knoblike cellular parts called the mastoid processes; the frontal bone shapes the forehead; while the sphenoid and ethmoid take part in the formation of the eye sockets, separate the brain from the nose, and form the floor of the cranium case. In each of the two temporal bones are three tiny bones—the *malleus* (hammer), the *incus* (anvil), and the *stapes* (stirrup)—of the middle ear (*see* Ear). The hyoid is a U-shaped bone in front of the neck at the root of the tongue.

The face requires 14 bones: a lower jawbone known as the inferior maxillary or mandible; two superior maxillaries to build up the upper jaw and part of the roof of the mouth; two nasal bones for the bridge of the nose, and the vomer for its partition; two inferior nasal conchae (also called inferior turbinated bones); two zygomatic (also called malar) bones for the cheeks; two lacrimal and two palatine bones. Of the joints in the cranium and face, only the lower jawbone is movable. It is joined to the temporal bone by a ball-and-socket joint.

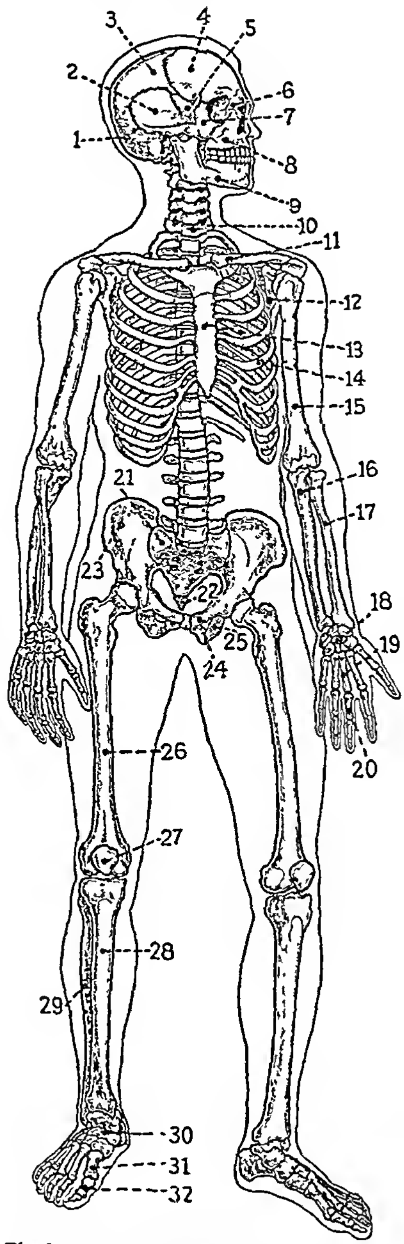
To lessen the weight of the skull, some of the bones contain sinuses, or spaces filled with air. The frontal sinus, for example, is in the forehead over the eye cavity. The sinuses communicate with the nose and are lined with mucous membrane. An infection in these cavities is commonly spoken of as "sinus trouble."

Jointed to the axial skeleton are the bones of the upper and lower extremities. These constitute the appendicular skeleton. The arms are supported by a shoulder girdle, which has on each side a clavicle or collar bone, and a scapula or shoulder bone. The humerus is the bone of the upper arm, and the ulna and the radius form the forearm. The hand has eight carpal or wrist bones, five metacarpals which form the palm, and 14 phalanges that make up the fingers.

The bony framework of the lower extremity is built on the same plan as the upper extremity. Each of the two hipbones, *ossa innominata,* is made up of three parts—the ilium, ischium, and pubis. The hipbones unite with the sacrum and coccyx of the vertebral column to form the pelvic girdle, which supports the legs. The femur, the patella, and the tibia with its neighbor, the fibula, form the leg. The ankle for flexibility has seven small tarsal bones; five metatarsal bones form arches that are like powerful steel springs propelling us along as we walk; and the 14 phalanges of the toes add further elasticity and make the act of walking more graceful.

The bones in our bodies are all smoothly jointed and firmly held together by flexible ligaments. The ends of the bones in each typical joint are padded with cartilage, covered with a thin sheath, the synovial membrane, and oiled with a lubricating fluid, so that we can use them constantly and yet they never wear out. In the juncture of two bones the movement permitted varies, therefore joints are classed as immovable, yielding, and those having free motion. Thus the joints of the cranium are immovable; the vertebrae are yielding; and the shoulder joint has free motion. The muscles in large part are attached to the bones across the joints, so that movements are brought about by the shortening or contraction of the muscles.

BONES IN THE SKELETON



The bones numbered above are: 1. Occipital. 2. Temporal. 3. Parietal. 4. Frontal. 5. Sphenoid. 6. Nasal. 7. Malar. 8. Superior maxillary. 9. Inferior maxillary. 10. Vertebrae. 11. Clavicle. 12. Scapula. 13. Sternum. 14. Ribs. 15. Humerus. 16. Ulna. 17. Radius. 18. Carpals. 19. Metacarpals. 20. Phalanges of fingers. 21. Sacrum. 22. Coccyx. 23. Ilium. 24. Pubis. 25. Ischium. 26. Femur. 27. Patella. 28. Tibia. 29. Fibula. 30. Tarsals. 31. Metatarsals. 32. Phalanges of toes.

SKIN. Human skin is composed of two main layers, the "epidermis" or scarf skin outside, and the "dermis" or true skin underneath. The true skin is studded and ridged with tiny projections above; the scarf skin is correspondingly pitted and furrowed underneath; and the two fit together like the parts of a puzzle. On the palms of the hand and the soles of

the feet these ridges become so prominent that the upper surface of the epidermis is ridged and furrowed in patterns of tiny whorls and loops which are unique for each individual, so that each person has distinctive finger-prints (*see* Finger-Prints).

We speak of "thick-skinned" and "thin-skinned" people, but we are all comparatively thin-skinned over certain parts of the body (about 0.5 of a millimeter or $\frac{1}{50}$ of an inch on the eyelids, for instance), and thick-skinned over others (4 millimeters—about $\frac{1}{6}$ of an inch—or more over the palms and soles). The skin is thicker over the back than in front, and on the outer than on the inner sides of limbs.

The outer layers of the epidermis are constantly drying up, flaking off, and being renewed from below. The deeper epidermis layers contain the pigment (*melanin*) that makes an Indian brownish-red, a Chinese yellow, and a Negro black. White skins look pink when they are transparent enough to let the blood show through them. Fingernails and toenails, like the claws and hoofs of the lower animals, and the hollow horns of the ruminants are merely thickened and hardened epidermis. Hair too is modified epidermis (*see* Hair).

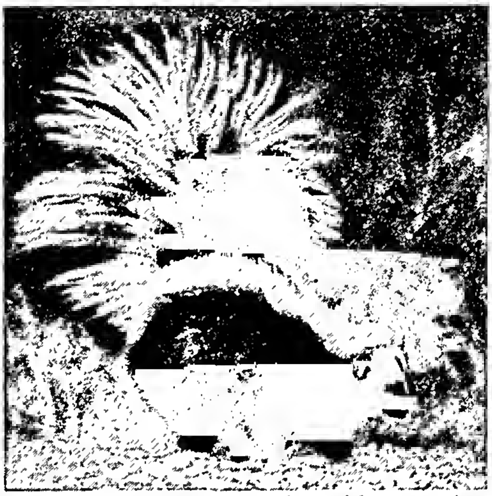
Two sets of glands pour their secretions over the skin. The flask-shaped sebaceous glands, situated in the true skin and usually associated with the hairs, occur practically all over the body except on the palms and soles. In health their oily semifluid secretion lubricates the skin and hair. Sometimes it hardens within the duct, forming a plug or "blackhead," which has to be pressed out. The sweat glands are set deeper and reach the surface through crooked ducts that end in the openings called *pores* (from the Greek *poros*, "passage"). These glands are scattered all over the body. They are most numerous in places where the sebaceous glands are absent—the palms and soles. There are estimated to be nearly 3,000 sweat glands to the square inch in the palms—more than six times as many as in the skin of the back. Their secretion, the perspiration, is essentially water.

The skin serves a threefold purpose: (1) Tough, and elastic, it protects the body tissues against injuries, and is especially thick and cushioned with fat where it is subject to constant pressure, as on the soles. (2) Much news of the outside world reaches us in the form of sensations of touch, heat, and cold through the special sense organs in the skin. Many of the tiny protuberances (called "papillae") on the upper surface of the dermis contain nerve-endings; these "tactile papillae" are especially numerous over the soles and palms. (*See* Touch.) (3) The skin helps to regulate body temperature. It is an insulator that keeps in heat. When extremely cold it warms itself by shivering. When too warm it cools itself through the evaporation of perspiration.

"Goose flesh" or "goose pimples" are caused by the contraction of tiny muscles at the hair roots. The reaction corresponds to the fluffing out of feathers by birds and of hair by furred animals. It takes place in the cold and in moments of excitement—probably a survival of the days when hairy men kept themselves warmer in this way and made themselves look larger to their enemies.

SKUNK. The common skunk is a peaceful little animal. He almost never attacks his neighbors. In return he expects to be let alone, and usually he is. The biting, evil-smelling liquid he can spray from the scent glands under his tail drives off all but the most reckless enemies.

OTHER ANIMALS RESPECT HIM



Skunks usually have black fur, with one or two conspicuous bands of white along their backs. Their tails are tipped with white. They are slow moving and never run from an enemy.

Skunks live in a family den—a hole in the ground or a snug hollow under rocks or fallen trees. Here, about the end of April in a grass nest built by the mother, 4 to 10 young skunks are born. They are the size of field mice. In about eight weeks they are out learning to dig up grubs and to strike down beetles and grasshoppers with their big paws. Later they will catch mice and feast on wasps and bees without seeming to feel their stings.

Days are for sleeping. Nights are for hunting. But sometimes in the late evening skunks play a queer game. The family forms a circle with their noses pointed toward the center. They hop forward until their noses touch. Then they hop backward. Maybe they will do this a dozen times, and then they waddle away for their nightly dinner—always in single file. When winter comes, skunks put on fat and retire to their dens, where they sleep most of the time until spring.

Skunks grow to the size of cats, though their long bushy tails and fluffy fur make them seem bigger. Most farmers like them in the fields because they destroy pests, but many are killed for raiding poultry houses. Trappers catch skunks for their fur, which is sold under the name of "black marten" or "Hudson Bay sable."

When taken young, skunks often make affectionate household pets. Sometimes the scent glands are removed, but since these are used only in extreme fright or anger, the operation is seldom necessary.

Scientific name of common or striped skunk is *Mephitis mephitis*. The smaller spotted skunk of the west and south is *Spilogale putorius*. This is the "hydrophobia skunk" of western legend, a name based on a few experiences with spotted skunks that had been bitten by "mad" coyotes. Skunks are sometimes called "polecats," but this term properly belongs to a European ferret, *Putorius foetidus*.

SLANG. There is a "vagabond language"—wild, free, racy, often vulgar—which refuses to follow the usual standards established by the best writers and speakers. We call it slang.

At its worst the use of slang tends to vulgarize one's speech, to limit one's vocabulary by driving out the more reputable words. It leads one to look for expressions that are in themselves striking or "different," rather than those which convey the exact shade of meaning. The slangy person whose adjectives are limited to "rotten," "punk," "swell," and "stunning" finds himself at a loss when he attempts to describe a thing accurately.

The Spice of the Language

At its best, slang lends spice to language. It is often forcible, vigorous, and picturesque. Slang expressions are sometimes homely but effective figures of speech (*see* Figures of Speech). Most slang expressions are short-lived; but in every age there are some of these vagabond words which are, as it were, admitted into respectable society and become part of the standard language. Had our forefathers never used slang, our language would be much poorer. "Blizzard," "skyscraper," "mob," "humbug," and "banter" were originally slang expressions. "Squelch" was found to be so convenient and expressive a word that it has been admitted into approved usage. So have many other words and phrases, formerly frowned upon, such as "swat," "hold up" (to stop in order to rob), "fill the bill" (to satisfy requirements), "graft" (to obtain public money dishonestly), "bluff" (to deceive by a confident manner), "nice" (in the sense of agreeable or pleasing), and "bogus" (counterfeit).

From its beginnings in the jargon or *argot* of criminals and vagrants or in the special language of various trades and professions, slang has spread to nearly all walks of life. The student talks of "boning" or "bucking" or "cramming" for an "exam." The actor waits to "see the ghost walk" (get his salary). The theatrical manager hopes the play will "register" or "get across" to the public. The writer prays his story will "click." The artist complains that his picture has been "skied" (hung too high in an exhibition). The speculator looks for a "slump in the market" if the "bears" triumph over the "bulls." And the person who always agrees with his boss is called a "yes man" or an "apple polisher."

The Picturesque Slang of War

The first World War stimulated much slang and near slang. "Doughboy," "Tommy," "poilu," and "boche" or "Heinie" or "Fritz" designated American, British, French, and German soldiers, respectively. A "gob" was a "jackie" or enlisted man in the United States Navy. An "ace" was a flier who had brought down five or more enemy planes. To the British soldier, "blighty" meant home; to "go west" meant to die. The Allied forces freely exchanged slang in the second World War. The Americans offered "goldbricking" (loafing on the job), "dogface" (a soldier), "goof off" (to get into trouble), and "sweat out" (to wait anxiously). The British popularized "rhubarb" (opportune target for bomber), "prang" (to crash in airplane), and "brassed off" (bored). The Australians contributed "cobber" (buddy), "dill" (stupid), and "dinkum" (on the up-and-up).

SLATE. School "slates" and the queer slate tombstones of colonial New England belong to a past day. But the dark gray (sometimes blue, greenish, purplish, or even red) stone from which they were made is still widely used for roofing, sinks, washtubs, flooring, blackboards, billiard table tops, mantels, etc. For all these uses slate is especially suitable because of its smooth, easily cleaned surface, and its property of splitting into thin slabs or leaves.

Most slates have been formed, by pressure, from sedimentary rocks first deposited by water as beds of clay. If such clay becomes structureless stone by the mere removal of uncombined water, it is mudstone, if, having been deposited in layers, it has a tendency to split along the bedding planes, it is shale; but if—perhaps having first been tilted up at a new angle—it has then been compressed by tremendous force, so as to spread it out and produce cleavage planes at right angles to the direction of pressure, it becomes slate. This tendency to split into thin slabs is so characteristic of slate that the name is sometimes applied to shale and almost any rock which splits in this manner—as anthracite slates, whet slates, and talc slates.

Slates are widely distributed, but those of good commercial quality are not. Most of the slate used in the United States is quarried in Pennsylvania, Vermont, New York, Maine, Virginia, Maryland, and Georgia. Most European slate comes from Wales and France.

SLAVERY AND SERFDOM. "Man has a back, and he will not work unless it is beaten." So runs an old Egyptian proverb, and in every age of the history of the world there have been men who have taken these words to be true. The earliest laws of Babylonia recognized that one man might own another man, as he owns a sheep or an ox, and do to him very much the same as he does to his sheep or ox; the Bible allowed slavery and nowhere says that it is wrong; Abraham armed "his trained men, born in his house, three hundred and eighteen." Among the Greeks, Aristotle, the greatest mind of the ancient world, said, "The lower sort of mankind are by nature slaves, and it is better for them, as for all inferiors, that they should be under the rule of a master."

In early times men often sold themselves or members of their family to pay a debt or merely to secure money for some end. In Greece and Rome a debtor could be enslaved by his creditor, though this was soon forbidden. The principal cause of slavery in the ancient world was that people of one country looked upon all other peoples as their inferiors, and therefore a conquering nation took not only the land and herds won in war, but the inhabitants as well. The Greek formula for a successful war ran, "They killed the adult males, and sold the women and children into slavery." Julius Caesar once sold 60,000 captives.

Slaves are never found in great numbers among simple pastoral and agricultural peoples. In general, slavery accompanied the accumulation of wealth. A family which found itself able to feed another mouth

HOW MAN POWER MOVED THE GALLEY

This Roman war trireme interior, reproduced for the motion picture 'Ben Hur', shows how scores of Roman galley-slaves bent their backs pulling the three banks of oars. Notice the chains and ropes that bound the weary men to their posts, and the dark hold where they sweltered when not on duty.

soon realized the convenience of having a slave to perform the heavy labor. But it was only in times of great prosperity and in settled societies, when nations had money to invest in large enterprises and when slaves could earn more than they cost, that slavery existed on a great scale. Though such conditions were found at times in Egypt and Babylonia, not nearly so much is known of the life of slaves in those countries as in others of the ancient world.

Slavery in Greece and Rome

There were slaves in Greece and Rome when those peoples were in the pastoral and agricultural stages, but in comparatively few homes and in small numbers. In the Homeric period, to judge from the references in the 'Iliad' and the 'Odyssey', slavery seems to have been well established. Early in the historic period, about the 5th or 4th centuries B.C., Athens was a center of industry, with thriving workshops in such numbers that there was more work than the Athenians could do. Slaves were brought in large numbers, principally from Thrace, but many came from Syria, Egypt, and other Asiatic countries. Native Greeks were also enslaved, sometimes sold as children by parents who could not or would not support them, sometimes seized by pirates and sold, but more often taken prisoners in war and held by their conquerors.

The conditions of these slaves in Greece, particularly the industrial slaves in Athens, were strikingly good, for the Athenians recognized that, if the slaves were to be efficient workers and produce articles of beauty and high craftsmanship which would sell in competition with the products of other cities, they must be willing laborers. The hope of freedom was held before them; they could save a little out of their earnings or their food, "cheating their stomach," as the Romans quaintly expressed it, lay by tips and presents, and ultimately purchase their freedom. One of the wealthiest bankers in Athens came there a slave, purchased his freedom, and was finally made a full citizen because of his benefactions to the city. A famous cook amassed enough money in two years to buy three small tenements. The slaves dressed like the other residents of the city, and the complaint was often heard that they refused to make way on the sidewalks before Athenian citizens.

In Rome slave labor was used to an extent never seen before or since. The hundreds of thousands of captives taken in her endless series of wars, and the enormous wealth which the aristocracy accumulated from these wars, made slavery the very foundation of the state. Many functions which today are carried on by free labor, except those of the higher offices of government, were performed by slaves. They were the physicians, teachers, governesses, house servants and farm hands, the actors on the stage, the acrobats and jugglers of the amphitheaters, the charioteers of the circus. They kept the books of the business man, carried on his correspondence, and had charge of much of the management of his affairs. In the service of the state they were the oarsmen of the fleet and, for a time, the marines as well. The great public works, such as aqueducts, docks, roads, and temples, were the work of their hands. The books in the public and private libraries of Rome were all copied by hand by groups of slaves sitting about a room following the dictation of one of their number who read the text to them from a single manuscript.

The gladiators who fought to amuse the crowds were captives in war who had been purchased by some wealthy Roman. They were trained in gladiatorial schools in the use of various kinds of weapons, and then rented to the emperor or private citizens

who were going to give an exhibition open to the public. Gladiators were in such demand that the owner of a band of trained performers could sometimes get back his entire original investment from one such contract. (*See* Gladiator.)

Some Celebrated Freedmen

Though never given the free movement in Rome which they enjoyed in Athens, the Roman slaves could still save money and in the end purchase their freedom. Scores of thousands of them were liberated by their masters (*manumission*) and could then become Roman citizens. Though some social stigma still clung to such a "freedman," as he was called, it usually disappeared in the second generation, and all civil disabilities were removed in the third generation, which enjoyed full citizenship. The great poet Horace, who gained the favor of Augustus and moved in the court circle of Rome, was the son of a freedman. Terence, Phaedrus, and many other Roman authors were themselves freedmen.

Far different from the lot of the slaves in industry and in the cities was that of their fellows on the great Italian and Sicilian plantations, and in the mines of Greece and Rome. In the fields they frequently worked in chains, and at night were bound together and shut into great prisons, half buried under the ground. The life in the mines beggars description. The famous silver mines of Laurium near Athens have galleries not larger than three feet square. Since these galleries were totally dark, the miners worked with clay lamps set in niches; these lamps could burn about ten hours, which was the length of the shift. The slaves worked in chains, almost naked, and branded with the mark of their owner. The life of such laborers was short, but the profit for their owner was large; so large, indeed, that one Greek writer seriously suggested that the city of Athens purchase 10,000 slaves and let them out for labor in the mines, since the state could in this way realize 33 per cent on its investment.

Early Protests Against Slavery

From the earliest times there was always protest among the Greeks and Romans against slavery. Homer saw the evil effect upon the slave himself: "For Zeus takes away the half of a man's virtue, when the day of slavery comes upon him." When the Greeks considered introducing gladiatorial combats into their games, the gentle philosopher Demonax bade them first cast down their altars to Pity. Other men saw that it drove down the wages of the free worker, that it brutalized the owner, and that it tended to make labor with the hands disgraceful. But few persons advocated its abolition, because they did not see how society could do without it. The slave was an animated tool; a gang of slaves was a machine with men for parts.

Slavery died out when the whole ancient world came to form one state, the Roman Empire. This was partly because the supply of slaves from war was cut off, but primarily because Roman wealth disappeared during the barbarian invasions, and the industrial life of Greece and Rome was displaced by the primitive agricultural society of the Middle Ages.

The number of the slaves in Greece and Rome has been greatly exaggerated. They never constituted more than one-half the population of the state of Athens, and probably not more than one-fourth of the population of the city of Rome. For Italy as a whole the proportion would be very much smaller. The brilliant civilization of Greece and Rome was not "based upon slave labor," as is so often said. The arts flourished because, in Athens and in the better factories of Rome, the slave was scarcely distinguishable from the free man, and because at the side of every slave there was at least one free laborer. Slavery did do one good thing: it gave some men leisure from deadening manual labor, so that they could devote their time to higher things. It did for the ancient world what machinery does for us today.

Serfdom Succeeds Slavery

In Europe slavery gradually disappeared after the 4th century and was rarely heard of by the end of the 10th century. In its place appeared serfdom (*see* Feudalism). The worker was no more the "chattel," or "thing," of his master; but he must render his lord a fixed portion of his services. Serfdom, like slavery, is nearly as old as man. The Egyptian pharaoh was in theory the owner of all the land of Egypt, the peasants owed him a part of their labor, and it was by the hands of these Egyptian serfs that the pyramids were built. The Persians did not enslave or move from their homes the peoples whom they conquered. They preferred to leave them as "royal peasants," as they were called, on the land, requiring them to render tribute to their conquerors in the form of money, products of the field and herd, and labor. The Greeks and Romans took over this institution with but little modification; something like it was to be found among the primitive Germans; and the Roman and German customs blended to produce the serfdom of the Middle Ages.

The serf, like the free peasant, held a few acres of the lord's land, but, unlike the free peasant, he could not move about at will. He was "bound to the soil," and when the land was sold, he went with it. If he fled from the estate, he could be brought back unless he could hide himself "for a year and a day" in some free city. His children also must remain on the land; he could not give his daughter in marriage nor have his son "tonsured" (allow him to become a priest) without the permission of the owner of the land. An old document gives the following list of the services owed by an English serf: For a definite number of days each year he had to harrow the land, carry manure, mow the meadow and gather the hay, haul in the harvest in the fall, bring wood to the manor house, and transport the crops to the nearest market. Besides these services he owed his master four shillings each year, and a cock and two hens at Christmas.

Serfdom was an integral part of feudalism, and there was little difference in principle between the serf who

owed his master the labor of his hands and the powerful vassal who owed his feudal lord the service of his arms in war. But serfdom lived on in many countries long after feudalism had passed away. In England it ceased soon after the end of the great Peasant Revolt in 1381; in certain parts of France it did not disappear until the thrilling night of Aug. 4, 1789, of the French Revolution, when the nobles renounced all their feudal rights. In Prussia it persisted until 1811, and it was not until 1861 that the czar Alexander II, by imperial decree, liberated the 40,000,000 serfs of Russia who had been increasing in number since 1700.

The Revival of Slavery

Slavery revived in the 15th century when Europeans first came into close and continued contact with the African Negroes. They were people of a different color and race, on a lower level of culture, and to the inhabitants of Europe they hardly seemed human. They were considered to be the "sons of Ham" of the Bible, ordained to be "hewers of wood and drawers of water" for the sons of Shem and Japheth. It was the Portuguese who, as they pushed down the west African coast in the 15th century, were the first to introduce into Europe the African slave. Portuguese ships carried slaves to Spain, and after the New World was discovered, descendants of these Spanish slaves were brought to Haiti to work the mines. At first the Spaniards tried to use the local Indians in the mines and on the plantations, but they were not adapted to such labor and were nearly exterminated. But the Negroes could endure that toil; and soon the slave ship with its "cargoes of despair," called by Milton

> That fatal, that perfidious bark,
> Built i' the eclipse, and rigged with curses dark,

was a regular sight on the ocean routes between Africa and the New World. The great ship companies of Europe bid against one another for the fortune which lay in this slave trade. By the Treaty of Utrecht (1713), England secured the sole right to supply Negro slaves to the Spanish colonies, and in 1739, when Spain tried to revoke the agreement, England went to war to keep it. The demand for slave labor soon passed from the West Indies into North America, and became so great that it is estimated that between 1680 and 1786 more than 2,000,000 slaves were brought into the West Indies and the English Colonies.

The First Nation to Abolish the Slave Trade

But as the true nature of this revolting traffic in human beings came to the knowledge of Europeans generally, it outraged the sense of justice of every thinking man. The Quakers had long protested against the trade, and their propaganda against it finally bore fruit. In the famous case of the Negro Somerset, the decision was handed down in 1772 by the courts of England that as soon as a Negro slave set foot upon the British Isles he became a free man. In 1776 the motion was made in the English House of Commons that "the slave trade was contrary to the laws of God and the rights of men." This motion did not pass, but the end was near. To Denmark belongs the honor of being the first Western nation to abolish the slave trade, in 1792; that example was followed by England in 1807, and the United States in 1808. Further progress was made at the Congress of Vienna in November 1814. Largely through the influence of England, the powers assembled agreed that the slave trade should be abolished as soon as possible, but left the actual date to negotiation among the various governments. The Webster-Ashburton Treaty in 1842, obligating Great Britain and the United States each to keep a naval squadron on the African coast to prevent shipment of slaves, may be taken as the date when organized African slave trading finally ended although for a time cargoes were run illegally.

The Abolition of Slavery by Law

It was well enough to stop the traffic in slaves, but what of the millions of slaves still in bondage and handing down this servile condition to their children? The leader in the agitation against slavery in England was William Wilberforce, who devoted the larger part of his life to denouncing it over the country and introducing measures in the House of Commons for its abolition. In 1833, a month after his death, a bill was passed emancipating the slaves in all British colonies and appropriating a sum of nearly $100,000,000 to compensate the owners for the loss sustained. The same step had been taken earlier by smaller states, but Britain was the first great nation to make slavery illegal. Its example was followed by other states. In the United States the slaves were freed only after a long, costly, and bloody war (*see* Civil War, American; Reconstruction Period).

Slavery Lives On

After the American Civil War most people thought that slavery was at an end; but inquiries made by the League of Nations showed that it survives even today. The Mohammedan religion recognizes the institution of slavery, though it commands the master to feed and clothe his slaves as he does himself, and encourages manumission as an act of piety; but the Koranic injunctions are not always observed.

Mohammedan traders in "black ivory" have for years found a sale for their captives in the slave markets of northern Africa and in the Arabian ports along the Red Sea and as far north as Turkey. There are today perhaps 3,000,000 human beings who are living under conditions which amount to slavery, chiefly in Ethiopia, Afghanistan, Arabia, northern Africa, and China. Under the system known as "peonage," in parts of South America laborers become involved in debt which they can never repay and so are no better than slaves for life.

In 1924 a committee was appointed by the League of Nations to investigate slavery and conditions similar to it, such as all forms of debt slavery, the enslaving of children under the guise of adoption, the acquisition of girls by purchase disguised as payment of dowry, and the like. Out of the report of this committee came the Slavery Convention of Geneva in 1926, by which the signatory states undertook to sup-

press the slave trade and to bring about, "progressively and as soon as possible," the complete abolition of slavery in all its forms. In 1933 the League appointed an Advisory Council of Experts on Slavery to gather facts and study the problems of countries in which slavery still exists. When the League went out of existence, the problem passed to the Human Rights Commission of the United Nations.

SLAVS (*slävz*). The Slavic peoples far outnumber those of all other European language divisions. Estimates of their number in Europe range from 140,000,000 to 172,000,000—almost a third of the total population. They are divided into three main branches: (1) the Eastern Slavs, in European Russia; (2) the Western Slavs, in Czechoslovakia and Poland; and (3) the Southern Slavs, or Balkan Slavs, chiefly in Bulgaria and Yugoslavia. Outside Europe, the Eastern Slavs (Russians) have spread over Siberia. America contains millions of people of Slavic descent.

Slavs are generally broad-headed (*brachycephalic*). Many mixtures with other peoples have blurred the original type, and today some are dark and others are fair. Even the origin of the name Slav is not clear. Some students say it stems from a word meaning "glory." They cite the city name *Ekaterinoslav*, translated as "the glory of Catherine." Others believe the humble word "slave" came from the fact that many Slavic captives were sold by their conquerors in the slave markets of Europe.

The other people of Europe first took notice of the Slavs early in the Christian Era. Slavic tribes then lived northeast of the Carpathians, between the Oder and Dnieper rivers. They were of the Aryan, or Indo-European, family of peoples. (*See also* Language.)

Slavs Form Many Nationalities

The Slavs then spread in all directions. Their dispersion weakened them. They were split into several nationalities by Asiatic invasions, migration, and internal conflict. Some Slav groups—such as Wends, Slovaks, Bohemians, and Dalmatians—lost their sovereignty through conquest, intermarriage of rulers, or voluntary acceptance of foreign rulers. An undisciplined aristocracy led Poland into decline, and it was dismembered at the end of the 18th century (*see* Poland). In the Balkans, Serbia and Bulgaria were overwhelmed by the Turks and were held from the 14th century until late in the 19th century.

Only the Slavs who overran Russia rose to world power. They grew in three main branches. The first and most numerous were the Great Russians, who centered on Moscow. Second were the Ukrainians, or Little Russians, in the southwest. And third were the White Russians in the west. Before the first World War the Russian Slavs ruled one-seventh of the world's surface. After the second World War they dominated, through their form of government, eastern Europe and a large part of Asia (*see* Communism; Russia).

Religion and Culture of the Slavs

The Slavs have been divided in their religious practise. Russian Slavs and most of those in the Balkans have historically belonged to the Greek Orthodox church. They use the Cyrillic alphabet, a modified form of the Greek. Western Slavs—Croats, Poles, Bohemians—became members of the Roman Catholic church and use the Latin alphabet. In 1945 Bulgaria changed from the Cyrillic alphabet to the Latin.

Despite their historic conflicts, the Slavs have kept a kinship among themselves. Usually Slavs have both brooding moods and gaiety. Most of them enjoy bright colors, neat gardens, careful handiwork, robust games, dances, and music. Out of their history and their customs have come some of the world's finest literature and music. Their writers include Dostoyevsky, Turgeniev, Chekhov, Gorki, and Reymont. Slav musicians include Chopin, Tschaikovsky, Moussorgsky, Paderewski, Dvořák, and Smetana.

SLEEP. Everyone knows the need for sleep and how we may dream while asleep. But scientists still do not know what causes sleep or the relation between fatigue and sleep.

One theory holds that sleep and fatigue are much the same. This theory states that before sleep comes the nerve cells have become fatigued by using up their reserve of energy material faster than it can be renewed. This is called the fatigue of excitation. Nerve cells also may become fatigued by accumulating waste products faster than they can be eliminated. Since the mental activities of reasoning, perceiving, and feeling use up energy, the brain and other higher nervous centers need rest from impressions coming from the sense organs. These periods of rest clear away the results of fatigue and restore ability to function when the sleeper is again awake.

Experiments seem to show, however, that while accumulations of waste materials or other general causes may bring sleep, the actual process of falling asleep is due to something else. One suggestion is that a certain nervous center, called the *vasoconstrictor* center, becomes fatigued and causes constriction of the blood vessels. Reduced blood supply then causes sleep. According to this theory a person wakes when rest has restored this center to its normal state.

An opposite theory suggests the existence of a "wakefulness center" in a lower portion of the brain (the hypothalamus). This center supposedly is stimulated by emotions and the mental activities involved in daily living. If one is unable to shut off these messages from the brain to the wakefulness center, one remains awake. Sleep, then, is a normal state of the body when it is in equilibrium—that is, not stimulated enough to be awake. A sleeping person has a low level of consciousness. Hunger, cold, dampness, or fear break up this condition and increase muscle tension. The wakefulness center is stimulated and the sleeper is awakened.

The nerve centers connected with the heart, breathing, and circulation do not sleep. In deep sleep they only slow down and rest. Brain wave tracings on the electroencephalograph have demonstrated that sleep is not an unconscious state. The outer layer of gray cells (cortex) of the brain is found to be operating; but it has been shown that when the source

of the waves shifts from the back of the head to the front, sleep has come. A brain made unconscious by an anesthetic does not give the same tracings as a sleeping brain. A person asleep is relaxed, semiconscious, and breathing slowly. His blood pressure is down, heart rate decreased, and body temperature lowered. His fingers are cool and his feet are warm. His eyeballs are turned out and up beneath his lids.

People differ in the amount of sleep they need because of differences in age, body structure, habits of sleep, and occupation. Each individual needs only as much sleep as is necessary for a feeling of well being.

Many psychologists think that sleep is a condition in which interest in the outside world has ceased temporarily. One goes to sleep when he has grown tired of the day's experiences by shutting out stimuli. A few psychologists consider sleep a withdrawal from everyday problems to a symbolic return to a period before birth. Each awakening is viewed as a new birth.

Some persons show a need for excessive sleep. They may find the world neither comfortable nor easy and escape by sleep. They can lessen or end this overdemand for sleep by planning their lives with daily goals which are within their power to attain.

The Nature of Insomnia

Inability to sleep is called insomnia. It may result from disease and organic malfunctioning. In the absence of disease, anxiety is the greatest cause of sleeplessness. A sense of lingering tension always accompanies insomnia. Often individuals have long hours of wakefulness with mental activities continuing regardless of a great need for rest. Their muscular tension is marked. When they eliminate these body tensions by relaxing, sleep comes.

A characteristic of worry and anxiety is insomnia alternating with sleep that is disturbed by vivid dreams and nightmares. Psychologists believe that anxiety arises from emotional conflict. Deep anxiety results from a conflict between fear and hope. To combat such conflicts it may be necessary to seek help from an adviser trained in psychology or psychiatry. Sleep should be wooed by directing one's thoughts from personal worries, problems, or plans to thoughts about things which please and relax. Muscular relaxation is important because it reduces nerve impulses from the muscles to the cortex of the brain. With such repose one is relaxed and sleep follows. A habitual time for going to bed and for getting up helps to overcome sleeplessness.

Psychological Nature of Dreams

A dream seems to be a residue of the mental activity of waking life. There are short dreams; others are long, complicated, and highly symbolic. Some dreams are pleasant; others are frightening. Dreams are usually quickly forgotten; a few are so vivid we recall them for days. A dream may be dreamed only once, but many repeat themselves with small changes. Dreams usually express the fulfillment of a wish or a fear. The wish or fear may have been conscious or unconscious in waking hours, but the dreamer's activity is being influenced by it.

There is displacement in dreams. People and incidents are only symbols even though they may be recognizable. Important incidents are often slurred over, and minor details seem important. Dreams sometimes are expressions of suppressed desires. Nightmares often express fears carried over from waking hours. The appearance of suppressed material in symbolic form may give the dreamer some satisfaction through indirect recognition of his needs and desires. This brings partial relaxation and leads to refreshing sleep.

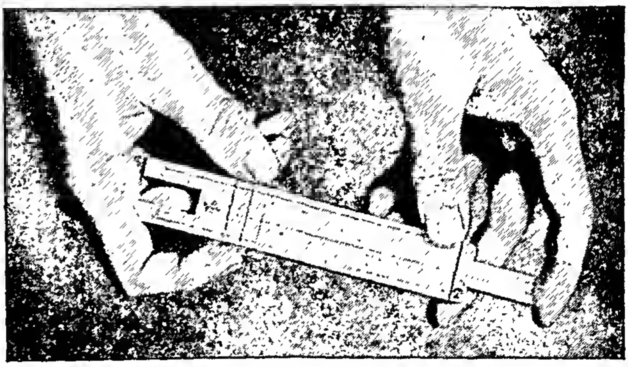
SLIDE RULE. The mathematical tool that looks like a number of rulers in one is the *slide rule*. Engineers, architects, scientists, businessmen, and others use it to make rapid calculations. With it, they multiply, divide, square and cube numbers, extract square and cube roots, and do other computations.

A simple slide rule has three parts. The *body* consists of two parallel rules, each with a scale on it. The *slide* moves between them and has two scales on it. The transparent *indicator* slides along the rule and has a hairline for reading the scale settings.

The principle of the slide rule is based on logarithms (*see* Logarithms). Numbers can be multiplied or divided by adding or subtracting their logarithms, and the slide rule does this mechanically. The figures on its scales are spaced proportional to their logarithms. To multiply numbers, the user sets them on the scales and reads the sum of their logarithms as the product; to divide, he subtracts logarithms.

John Napier invented logarithms (1614), and Edmund Gunter, a logarithmic scale (1620). William Oughtred (1630) and Amédée Mannheim (1859) made improvements. Slide rules are made in various shapes and sizes and with scales for special computations.

THIS TOOL SPEEDS CALCULATIONS



By moving the scales and the indicator, many mathematical operations can be made quickly and easily on the handy slide rule.

SLIME MOLDS. Decaying logs, fallen leaves, and black soil in forests often bear slimy orange or yellow masses from the size of a pinhead to that of a man's hand. These masses, called *slime molds*, cannot readily be classified as either plants or animals. The ordinary body is a mass of naked protoplasm, called the *plasmodium*. This body slips along like a gigantic amoeba. In certain conditions these slimy bodies come to rest and organize elaborate and often very beautiful spore cases. Botanists call the slime molds *Myxomycetes;* zoologists call them *Mycetozoa.*

SLOTH. These curious animals derived their name from the fact that they usually appear lazy and sluggish in movement, though at times they show considerable agility. Sloths live in trees in the forests of Central and South America; they are indeed the most strictly tree-inhabiting of all quadrupeds. By means of their hooklike claws they cling to the branches with their backs downward, and so appear upside down. They rarely descend to the ground, and crawl on it with difficulty. Their food consists of leaves, young shoots, and fruit. They are silent inoffensive animals and move about mostly at night.

HE WALKS UPSIDE DOWN

The sloth never, if he can avoid it, walks upright upon the ground. Even in his sleep he hangs upside down.

There are two sub-families of sloths—the *ai*, or the three-toed sloth; and the *unau*, or two-toed sloth. Both are covered with long coarse hair, the shafts of which are roughened or fluted. This hair is naturally grayish, but in the damp forest it is covered with a growth of algae, imparting a peculiar greenish color which makes the animal difficult to distinguish among the foliage. In dry climates the algae disappear and the hair resumes its natural color.

Scientific name of three-toed sloth, *Bradypus tridactylus;* of two-toed sloth, *Choloepus hoffmanni.*

SMELL. The most remarkable fact about our sense of smell is the excessively small amount of substance needed to stimulate the nerve endings in the nasal passages. Some substances can be detected if as little as one thirty-billionth part by weight is present in a given weight of air. Many animals have a far keener sense of smell than man. Just imagine how infinitesimal must be the traces left which enable a bloodhound to follow a criminal many hours after he has escaped! Every dog can recognize his master by the odor, which shows that every human being must have a different odor, though it is ordinarily so faint as to be imperceptible to our own sense of smell.

In primitive men, just as in animals, smell was probably of importance in locating food and avoiding enemies. If you wish to know how different people would be if their sense of smell were as acute as that of the dog, read the story by Mark Twain entitled "A Double Barreled Detective Story."

Smell is closely related to taste, each sense being aroused by chemical substances coming in contact with the nerve endings. In the case of smell the substance must be in the form of a gas. Gases diffuse through the air, consequently we can recognize things at a distance by their odor. The endings or receptors for smell cover a very limited area in the upper part of the nasal cavities. They are so arranged that the air is drawn over them when we breathe.

Many foods have a distinct odor, and the gaseous particles reach the smell receptors when we eat. Hence we confuse taste and smell. The so-called taste of fruits and wine is really an aroma or smell. Test this by holding your nose and chewing some dry coffee. You will not "taste" anything, but the instant you take a breath the so-called "taste" of coffee will become apparent. This explains why food does not "taste" right when you have a cold. Your sense of smell is lost by the partial stoppage of the nasal passages.

The many kinds of smells have been divided into nine classes. But the actual number of fundamental odors or kinds of olfactory endings is not definitely known.

Smells are intimately related to the emotions. Hence the division of odors into agreeable and disagreeable is probably fundamental and forms the basis on which many animals take their food and know their enemies and mates. Among civilized men likes and dislikes may be cultivated, hence people do not agree as to which odors are pleasant.

SMITH, CAPTAIN JOHN (1580–1631). The story of the life of Captain John Smith, as told by himself, reads more like a tale from the 'Arabian Nights' than like a true autobiography. According to his own account he ran away from his home in England at an early age, to seek adventure. While traveling through France he was robbed and left helpless in a forest, but was saved from death by a kindly peasant. Sailing from France with some pilgrims bound for the Holy Land, he was thrown overboard by his companions because they regarded him—a Protestant heretic and unbeliever—as responsible for the storm by which their lives were threatened. He saved himself from the sea, however, and later fought in a war against the Turks, three of whom he killed in a single combat. He was afterward captured and sold into slavery by the Turks, but made his escape by killing the guard placed over him. After wandering through Europe, he returned to England in 1605, and joined an expedition which was preparing to go to America to found the colony of Virginia.

During this voyage Smith's life was again in danger. He was accused of conspiracy, and at one time members of the party prepared to hang him. His life finally was spared, but he was kept under restraint until after the expedition reached the James River. Then it was found that Smith was one of the councilors who had been appointed by the Virginia Company in England to govern the colony. Soon he was forced by the incompetence of others to take the lead in the Jamestown settlement. He compelled all to work by his famous order, "He who will not work shall not eat." He traded with the Indians to supply the colonists with corn, and at the same time kept the savages in order.

Soon after the settlers landed, Captain Smith had a very exciting adventure. It was generally believed that the "South Sea" (Pacific Ocean) lay just beyond the mountains, so with a few companions Smith sailed up the Chickahominy River in search of it. When the stream became too shallow to go farther by boat, he landed and with one Indian pushed forward through the forest. Soon he was set upon by a band of hostile Indians and made captive. They were about to shoot him with their arrows when he aroused their curiosity by showing them his pocket compass, and they spared his life. After taking him to many of their villages, they finally brought him before their chief, Powhatan, a tall stalwart man dressed in a coonskin robe. Presently the Indians seized Smith, bound him, and laid his head upon a stone, while a warrior stood ready to slay him with a club. At this moment, according to Smith's account, Powhatan's little daughter Pocahontas sprang forward, clasped her arms about the captive's neck, and prevailed upon her father to spare his life. The truth of this romantic story is doubted by many, but the value of Captain Smith's services to the colony is acknowledged by all. (*See also* Pocahontas.)

CAPTAIN JOHN SMITH BATTLES THE TURK

Captain Smith, as the champion of the Christians, killed three Turkish champions in turn. At this period (about 1600) the full suit of war harness had already gone out of use for common soldiers, but was still worn on special occasions by great nobles, and as you see here, by chosen champions.

While out on one of his many exploring expeditions Captain Smith was wounded by an explosion of gunpowder, and in 1609 he returned disabled to England, and never again set foot on Virginian soil. After recovering from his wound, however, he explored and charted the coast of southern Canada and northern United States, to which at his request Prince Charles gave the name of "New England." He also spent much time in writing, and although his works are not fully reliable, his 'True Relation of Virginia', his 'Travels', and his 'General History of Virginia' still furnish us much valuable information concerning the Jamestown settlement.

Doubtless Captain Smith was something of a kindly braggart and had an over-vivid imagination. But most certainly he was also a very active, courageous, resourceful gentleman—"ever hating baseness, sloth, pride, and indignity more than any dangers"—and to him more than to any other one man was due the success of the first colony in Virginia.

Smoke. The vapor produced when fuel burns is called smoke. If burning, or combustion, is complete smoke is invisible. But usually bits of ash or flakes of partially burned carbon, called soot, color the smoke gray to black. Wood smoke is almost colorless, consisting mainly of carbon dioxide and water. Bituminous coal gives off a dark smoke containing an oily vapor and much soot. The kinds of gases in a smoke depends upon the ingredients in the fuel.

Industrial cities are blackened by the smoke clouds arising from factories, mills, steam railway engines, bus and automobile exhausts, and home-heating plants. The monthly fall of soot and dust may average between 60 and 80 tons to the square mile. This grime adds to the citizens' bills for cleaning and laundry and painting and decorating. Smoke containing considerable sulphur or sulphur compounds corrodes iron and steel, causes masonry to crumble, and kills growing plants. Smoke combined with fog has been called *smog* (*see* Fog).

Many cities have undertaken smoke-control programs. By means of laws and educational campaigns, they encourage factories and householders to use the equipment that promotes thorough combustion or to burn smokeless fuel. Many industries use electrical or electronic smoke precipitators in their smoke stacks.

SMUTS, JAN CHRISTIAAN (1870–1950). In the final struggle of the Transvaal Boers against the British which culminated in the Boer War of 1899–1902, there were few leaders who were abler or more devoted to the Boer cause than Gen. Jan Smuts. He was the descendant of a long line of Dutch farmers, but after graduating from a Cape Colony college, he had a brilliant career at Cambridge University, England, where he had studied English constitutional history and law with Frederick William Maitland, the greatest living master of these subjects. On returning to South Africa he had soon attracted the attention of President "Oom Paul" Kruger, who appointed him state-attorney of the Transvaal when he was but 28 years old. Then when the Boer War came he won great praise as a general for his skill in carrying out rapid movements; no leader more skilfully evaded the traps set by the British, and none did more to delay the final crushing of Boer resistance.

JAN SMUTS
Boer Soldier and British Statesman

Yet less than a score of years later this brilliant enemy of British rule had become the prime minister of the whole British Union of South Africa, and was recognized as one of the greatest living statesmen of the British Empire.

In the reorganized Transvaal he had become the right-hand man of Gen. Louis Botha, the leader of the People's Party, and in 1906 had journeyed to England with him and received from the Liberal leaders of the British government the promise that the Transvaal should receive self-government. In return Smuts and Botha promised loyalty on the part of the Boers to Great Britain, a promise which they kept.

Smuts played a considerable part in bringing about the Union of South Africa (1909), and when Botha became prime minister of the Union, Smuts was made minister of defense of the interior, and of mines. He was one of the few British colonials who realized that Germany was preparing for a great war, and he feared that the Germans would use native troops—as they did—in the attempt to sweep the British from South Africa.

When the first World War broke out in 1914 many of the Boers, stirred up by Germany, sought to free themselves from British control by rebellion. But Smuts and Botha had promised loyalty to the British Empire and they kept their promise. They put down quickly and harshly the Boer rebellion. Then Smuts led a military expedition across the desert of German South-West Africa and won that territory for British rule. He headed the expedition to German East Africa, where his brilliant military strategy won reluctant praise from even the German army critics.

By this time Smuts had been marked out in Britain as an important military and political figure, so he was summoned from South Africa to represent that country in the Imperial War Conference. Then he was invited to attend the meetings of the British War Cabinet, and at the close of 1918 was employed in secret negotiations with Austria for peace. During the last year of the war, he made many speeches in Britain, speeches that won world attention and marked him off as the great spokesman for British Liberal opinion. He never doubted the outcome of the war, such was his faith in the final victory of moral issues; they were stronger than armies and would prevail. He did a great deal to keep up the spirits of wearied Britain. Like President Wilson he hoped for a new world after the war; like Wilson he wished for just boundaries based upon nationality, dreamed of a peace treaty that would bring about the reconciliation of nations and make for the ending of wars, and favored a League of Nations. But he was never so optimistic as Wilson; he never was so sure that the League of Nations could be established full-grown.

General Smuts went to the Peace Conference as the representative of South Africa. He helped frame the Covenant of the League, but he was dissatisfied with the spirit of the conference. He signed the treaty but issued a statement criticizing it.

Upon Botha's death in 1919, Smuts became prime minister. In 1924 he was defeated by Gen. J. B. M. Hertzog, leader of the Nationalist party, which proposed separation from the Empire. But, when the second World War broke out in 1939, parliament voted to support Britain and restored Smuts as premier. He declared war on Germany, and in 1941 was made field marshal. Despite his age, he appeared at battle fronts, took part in Allied councils, and helped to organize the United Nations. In 1948 the Nationalists again won control and forced Smuts to resign.

SMYRNA (*smûr'nạ*), TURKEY. The Turks call Smyrna "the eye of Asia" because, through its beautiful harbor on the Aegean Sea, Asia looks toward Europe. It is the most important seaport of Asia Minor and one of the oldest cities in the world. Its modern name is Izmir (*ĭz-mĭr'*). A ruined fortress on Mount Pagos, above the city, built by a general of Alexander the Great, is one of the few remains of Smyrna's early greatness. The city was ancient even in Alexander's time. Pindar, the Greek poet, mentioned it in an ode written about 500 B.C., and it was one of the seven cities that claimed Homer. Polycarp founded an early Christian church in Smyrna, where he was martyred in A.D. 155. Greece, Rome, and Byzantium ruled the city in turn. It was repeatedly seized by the Turks, was sacked by Timur Leng (Tamerlane) in 1402, and in 1424 was finally subdued by the Turks.

At the close of World War I Greece was given administration over the district, but in 1922 Turkey recaptured it. A few days later fire destroyed most of the city, and thousands of Greek and Armenian refugees lost their lives. The Treaty of Lausanne (1923) returned Smyrna to Turkey, and the large Greek population was exchanged for Turks living in Europe. In 1928 the city was leveled by an earthquake.

The Turks built a new model city on the shore and covered the land behind it with parks and artificial lakes. Close to the water front are the grounds of the International Fair, held annually after 1933; and the Bourse, where exporters buy figs, Turkish tobacco, raisins, and valonia (used for tanning). These products are prepared for export in large packing plants. Smyrna carpets, once famous for their beautiful color harmonies, have been largely replaced by factory-made rugs. Population (1950 census), 230,508.

"Stomach-footed" CREATURES *of* LAND *and* SEA

SNAILS AND SLUGS. Famous for the "snail's pace" at which they travel and for their "sluggish" behavior, these interesting creatures are nevertheless remarkably well adapted to life. Thousands of different kinds live throughout the world. They may be found almost everywhere—on land, in trees, in fresh-water ponds and streams, and in salt water from shore line to ocean deeps. Snails have shells. Slugs are without shells.

Snails and slugs are *mollusks,* a group which also includes the oyster, clam, mussel, octopus, and squid. All mollusks have soft bodies and a flap of tissue, called the *mantle,* which folds to enclose a cavity containing the lungs or gills. Snails and slugs differ from other mollusks in having a distinct head and a broad, flat mass behind the head—the "foot." This foot comprises the under surface, or stomach, of the snail. Hence they are called *gastropods,* meaning "stomach footed."

Land and Fresh-Water Snails and Slugs

Land and fresh-water snails live in moist woods and gardens and in ponds and streams. In warm climates some kinds live on trees. They carry their fortress on their back in the form of a cone-shaped, spirally twisted shell. When danger threatens they draw the soft parts of the body inside the shell.

The shell is secreted by the outer layer of the mantle. As the snail grows, it adds coil after coil, building from the open, or mouth, end as fast as it needs more room. Some of the most beautiful of animal structures are the snail shells (*see* Shells).

The head and foot reach out of the front end of the shell. The land snail's head has one pair of short tentacles; and above them, another pair of long tentacles. On the tip of each of the longer tentacles is an eye. The common pond snail has only one pair of tentacles, with the eyes at the base. If a snail loses one or both of its "eye horns," it can grow others to replace them. There are no chewing jaws. Snails shred their food, chiefly plant material, by

This tree snail is found in southern Florida. Most beautiful of the North American land snails, it is banded with gay colors. It lives in trees and feeds on leaves and bark.

means of a ribbonlike organ covered with hundreds of small teeth. It is called the *radula* ("little file").

The foot is tough and muscular. It contains glands which pour out a slimy fluid that makes it easy for the snail to move over any surface. Both fresh-water and land snails breathe air by means of simple, saclike lungs. The water species come to the surface to breathe. The breathing pore may be seen just under the edge of the shell, near the head.

Slugs have no outer shell, but vestiges of shell are embedded within the mantle. Their bodies are straight, not coiled like the snails. The common garden slugs are black or dark brown, less than an inch in length

when fully extended. The great gray slugs, which reach a length of three to four inches, have been introduced into the United States from Europe. They are very destructive to garden crops.

Both snails and slugs have a remarkable homing instinct. Marked animals are known to return to the particular area, even to the same plant, from which they were removed. Probably they are directed by their very delicate sense of smell, located in the tentacles. They hibernate in the winter; and in the South they estivate to escape hot dry spells. They conceal themselves in some sheltered place and, withdrawing into the shell, seal up the opening with a slimy substance which hardens. Both snails and slugs multiply by laying eggs, which hatch as tiny snails.

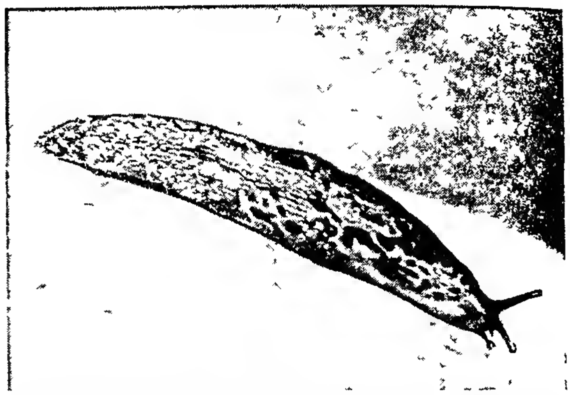
Salt-Water Marine Snails and Slugs

Salt-water snails and slugs breathe by means of gills instead of lungs. They seal the opening of the shell with a horny disk called the *operculum*. The eggs are laid in enormous numbers in leathery capsules, often most fantastically shaped. They hatch into larvae called *veligers*, which swim by means of numerous fine vibrating hairs. Soon the larvae settle down, lose their hairs, and develop into snails. Many marine species feed on seaweed and other plant life, but some are carnivorous.

The rocks on seacoasts are often almost covered with little marine snails known as *periwinkles*. They spend much of their time in air when the tide is out and resist drying by retiring into the shell and closing the opening with the operculum. The big *whelk* is a carnivore. It seizes its prey with the large foot and attacks it with a long extensible proboscis which has the radula at its tip. Winkles, drills, conchs, and abalones are all species of snails.

Pteropods are tiny snails that swim in the open ocean by flapping finlike extensions of the foot. The uncoiled, vaselike shell is thin and transparent as glass. Pteropods may cover the surface of the sea for miles. They constitute the chief food for many fishes and whales. Among the most beautiful of all sea creatures are the *nudibranchs*. They are slugs that have lost both shell and mantle. They breathe through fingerlike projections along the sides of the body. Exquisitely colored, the various kinds have bizarre shapes.

THE COMMON SLUG



The slug has no external shell but retains a thin plate embedded in the mantle. It secretes a slime upon which it glides.

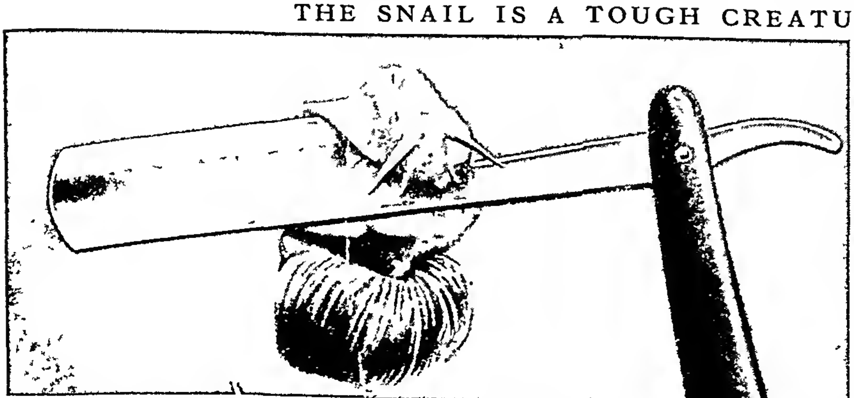
Economic Importance

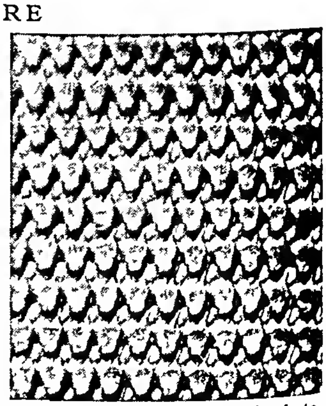
Different kinds of European snails of the genus *Helix* are considered a choice food. Periwinkles and abalones are also eaten. Snail shells were used as money by primitive peoples. A sea snail (*Murex*) was the source of the dye known as Tyrian purple.

Some snails are a menace to public health because they are hosts to disease-carrying worms known as flukes (*see* Worms). Drills and conchs are ruinous to the oyster industry (*see* Oyster). A giant land snail (*Achatina fulica*), native to the east coast of Africa, is a menace to agriculture. This snail reaches a body length of nearly nine inches and has a shell as large as a man's fist. It devours all green vegetables, fruits, and even flowers. It has spread eastward across Asia. During World War II it was introduced into the Pacific Islands by the Japanese as a food source. There is now danger of its entering the West coast of the United States on incoming cargo.

Snails and slugs belong to the class *Gastropoda* of the phylum *Mollusca*. The air-breathing fresh-water and pond snails belong to the order *Pulmonata*. Marine slugs and snails belong to the order *Opisthobranchiata*.

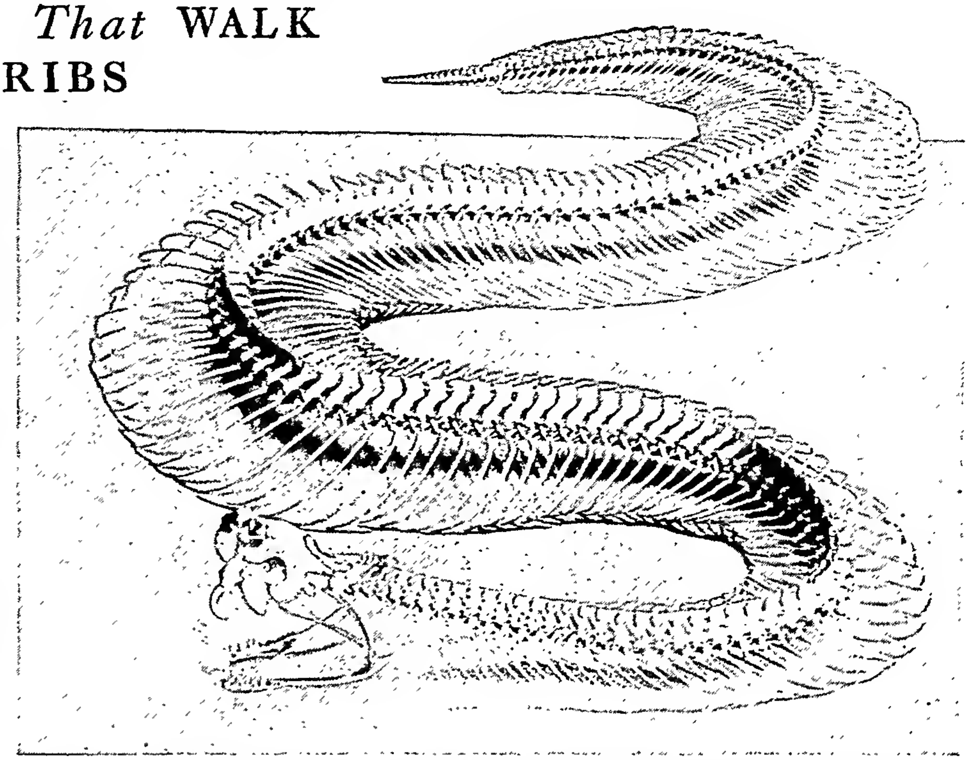
THE SNAIL IS A TOUGH CREATURE





The leathery skin of the snail's foot is so tough that the creature can climb over the edge of a razor blade without injury (left). The tongue of the snail (right), called the *radula*, has hundreds of tiny "teeth" with which it files away bits of food. This photograph shows some of the teeth magnified 40 times. Most land and fresh-water snails feed on fresh or decayed plant materials.

CREATURES *That* WALK *on Their* RIBS



This skeleton of an African viper reveals its amazing construction. To the flexible backbone are attached 145 pairs of ribs. The text tells how snakes use those ribs for "walking."

SNAKES. As far back as we can go in history, we find that snakes have exerted a strange fascination upon men. In olden times they were worshiped as gods or friends of the gods; they were symbols of wealth and knowledge, and the "wisdom of the serpent" was the subject of many a proverb. Among the Greeks they were dedicated particularly to Aesculapius, the god of medicine. The part which the serpent played in the Garden of Eden is well known. In the Middle Ages they became associated with black magic and evil spirits, and countless myths center about monstrous serpents guarding treasures in caves, or dwelling in the depths of the sea. The majority of people even in civilized lands continue to look upon snakes with unreasoning fear and dread. It isn't the danger of being poisoned that causes this, for the feeling exists toward snakes that are known to be harmless.

The fact is that snakes are indeed uncanny in appearance and habits. In the first place, they never close their eyes. They can't, for *they have no eyelids*, but only a tough transparent membrane to protect the eyeballs. This gives them that "cold and glassy stare" with which they are popularly supposed to hypnotize their prey. Another "creepy" spectacle is to see a snake crawl out of its old skin, appearing clean and glossy in its new dress. This habit of shedding their skins formerly led people to believe that snakes were able to renew their life from time to time, and that they never died. Even when cut in two, the two parts were wrongly supposed to crawl together again and be mended.

A KING SNAKE CONQUERS

This is a battle to the death between a king snake and a copperhead. You can see how the king snake has coiled around his weaker foe, whose fanged head is already hanging powerless.

How Do Snakes Get About?

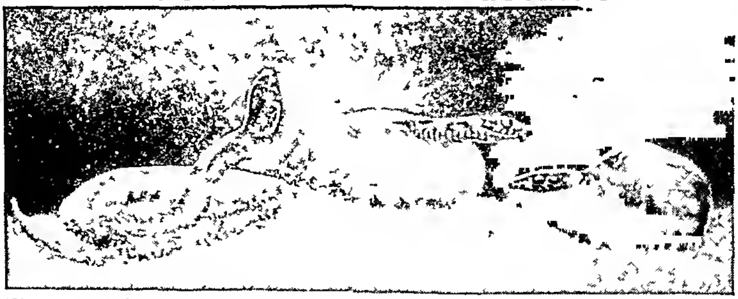
But more impressive and mystifying than anything else is the motion of snakes. Their legless bodies seem to flow like living streams of water, with apparently nothing to push them or pull them. They crawl over stones, up the trunks of trees, wind themselves in the most intricate coils, then untangle again, rear their heads in the air, or glide through some narrow hole—all without seeming to exert a single muscle or move a single bone.

The secret of this is that a snake *walks with its ribs*. These are very many in number, each being fastened to a section of the backbone, and each section of the backbone being connected with its neighbors by ball-and-socket joints, which permit the greatest freedom of movement. The tips of each opposed pair of ribs are attached with muscles to one of the cross-wise scales of the abdomen. Thus the snake can move each of these scales independently, so that they act as feet, their sharp edges catching on any small roughness in the path of travel, and as they are drawn backward, pushing the snake's body ahead. When snakes are in no hurry, they usually move in a perfectly straight line, but for speed they throw their bodies into a series of *S*-shaped curves. No snake, however, is able to leap off the ground by the power of its coils. Even when it strikes at a victim with

lightning swiftness, its does not slide forward and cannot, therefore, reach farther than its own length.

Snakes are silent secretive creatures. They appear and disappear with soundless mystery. When cornered and excited they have no voice, except a long sinister hiss. Wild animals in general appeal to us by their cries, like a half-understood language. But snakes make no such appeal; even the noise of the rattler is a "dead inhuman sound."

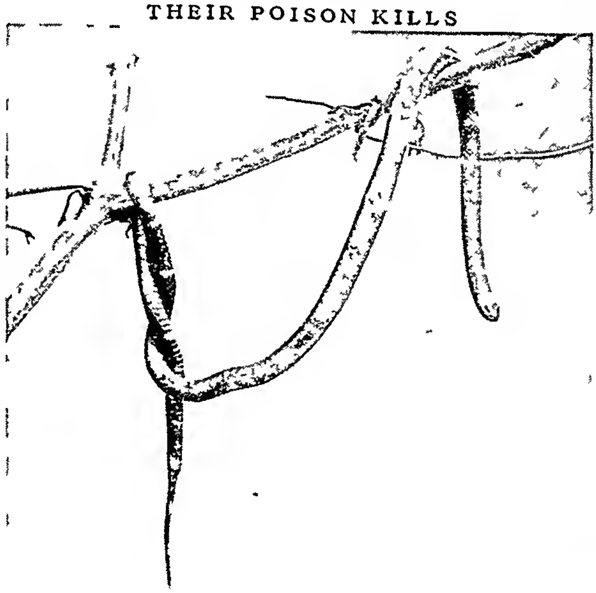
RING-NECKED SNAKES HATCHING



The ring-necked snake is one of the species which lay eggs. Two of these young snakes are just breaking through their shells, while a third is stretching itself for the first time.

Yet when you see a snake's deep-cut mouth, curved back as in a cruel smile, and catch a glimpse of the forked tongue, darting in and out like an electric spark, it seems as if the creature could speak if it only would. In fact, however, this exhibition denotes chiefly fear and curiosity. The snake would gladly escape if it could, but instinct tells it that its long thin body is in great danger when stretched out flat on the ground; a slight blow will break its back. So it coils and hisses hoping to drive you away; and its forked tongue, which is believed to be a sense organ like the feelers of insects, is extended from its sheath on the lower jaw in the hope of finding out what sort of a being you are.

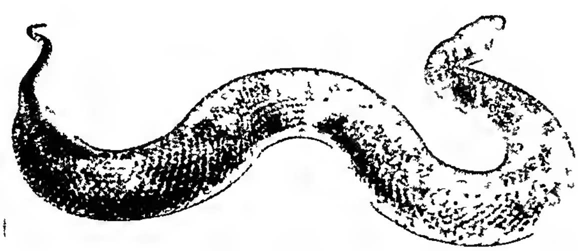
THEIR POISON KILLS

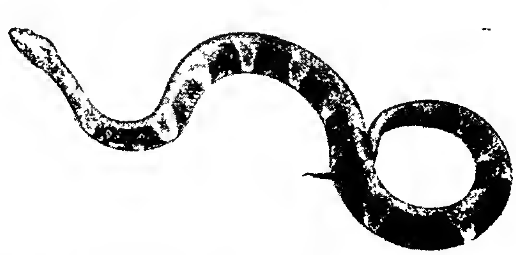


The prejudice against snakes has always blocked a better knowledge of them, yet they present an opportunity for a fascinating study. As we shall see later, there are only four kinds of poisonous snakes in North America outside of Mexico. Comparatively few people are killed by their bites, because the snakes usually do everything in their power to avoid contact with men. The victims of most of the fatal accidents are persons who become careless with captive snakes.

Nearly all snakes catch and kill their prey, which, according to the snake's size and habits, may consist of insects, fish, frogs, lizards, other snakes, birds and their eggs, rats, mice, rabbits, gophers, and other small mammals. Many snakes, like the boa constrictor and anaconda of South America, the common king snake of the United States, and others, wrap themselves around their victims and crush them by constricting or drawing together the folds of their bodies. The constricting power of a 20-foot anaconda is doubtless great enough to kill a cow, but stories of these snakes devouring cattle, horses, or men are untrue. (*See* Boa Constrictor.) The poisonous snakes usually rely on their venom to put an end to the struggles of their prey. The others simply swallow their catch without attempting to kill it first. This accounts for the fact that snakes which are disturbed immediately after a meal sometimes disgorge live frogs, lizards, or other prey.

The size of the morsels which snakes can swallow is astounding and indicates one of the important





Here are the three snakes which, with the Rattler, are the only poisonous snakes in the United States and Canada. At the top is the Coral Snake, a small creature with red, yellow, and black rings around its body. The heavy-bodied snake below is the Water Moccasin, while the one with the light and dark patches is its near relative, the Copperhead.

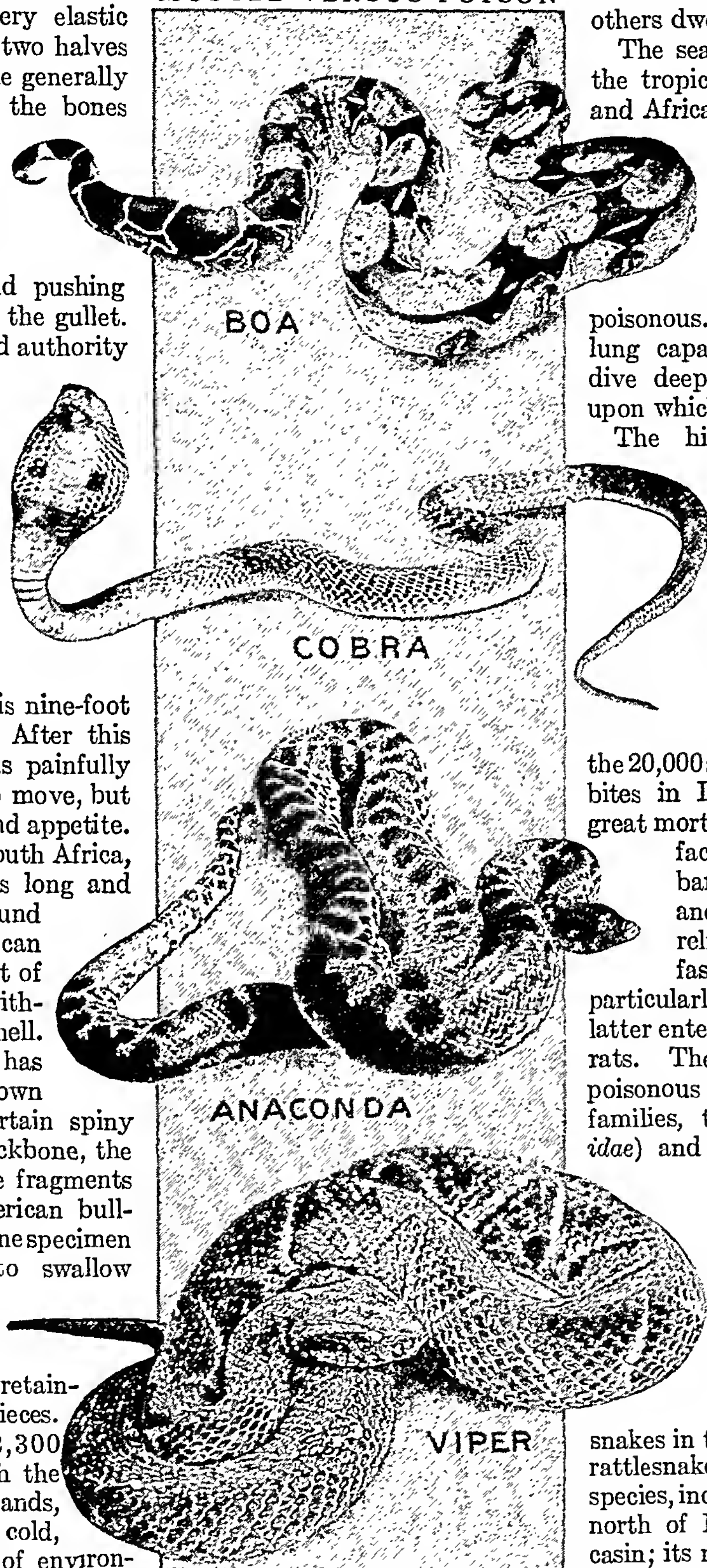
peculiarities of a snake's structure. This consists in the very elastic connection between the two halves of the lower jaw, and the generally loose attachment of all the bones around the mouth and throat which permits wide stretching. The teeth are sharp and curved backward, well suited for gripping and pushing the prey far down into the gullet.

A story is told on good authority of two captive boa constrictors which started to swallow the same pigeon from opposite ends. When their noses met in the middle, both were either unable or unwilling to stop their meal. The result was that one which was slightly larger swallowed the pigeon and his nine-foot brother snake as well. After this dinner, the survivor was painfully distended and unable to move, but soon recovered health and appetite.

The "egg-eater" of South Africa, which is rarely 20 inches long and not much bigger around than a man's finger, can perform the amazing feat of swallowing a hen's egg without breaking the shell. When the egg, however, has passed a few inches down the neck it strikes certain spiny projections from the backbone, the shell is broken, and the fragments vomited out. The American bull-snake is less particular, one specimen having been known to swallow 14 eggs in succession, crushing the shells by pressing its stomach against the ground, but retaining and digesting the pieces.

There are about 2,300 species of snakes. With the exception of a few islands, and regions of extreme cold, they exist in all sorts of environment—in dense tropical forests, in deserts, on high mountain tops. Some burrow in the ground, some live entirely on the surface, some spend most of their time in trees; others frequent swamps or fresh-

MUSCLE VERSUS POISON



The Boa and the giant Anaconda are among the most powerful of all snakes, catching and crushing their prey in their powerful coils. Yet the Cobra and the Viper, small as they are in comparison, can kill creatures the other two would not dare to attack, for they possess deadly poison fangs. These pictures, of course, do not show the relative sizes.

water lakes and rivers; and still others dwell in the sea.

The sea-snakes, found mostly in the tropical waters bordering Asia and Africa, usually have the body flattened from the sides, which makes them powerful swimmers, but awkward on land. They number about 50 species—all exceedingly poisonous. They have tremendous lung capacity, so that they can dive deep in pursuit of the fish upon which they feed.

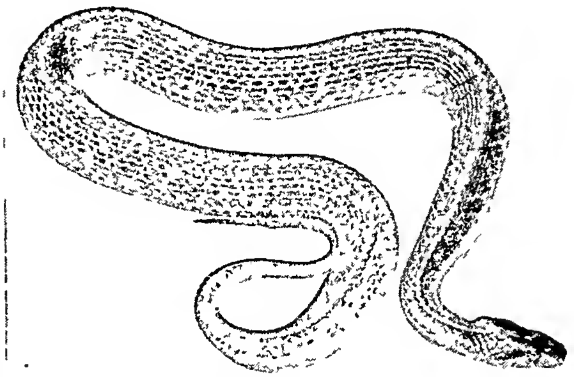
The highly poisonous snakes found on land number not more than 250 species, of which 150 belong to the family called *Elapidae*, which includes the cobra and the "krait," the two most dangerous of all snakes, and which are chiefly responsible for the 20,000 annual deaths from snake bites in India (*see* Cobra). This great mortality is chiefly due to two facts; that the Hindus go barefooted through fields and jungles; and that, for religious reasons, they steadfastly refuse to kill snakes, particularly cobras, even when the latter enter their houses in search of rats. The remaining 100 highly poisonous snakes belong to two families, the true vipers (*Viperidae*) and the pit vipers (*Crotalidae*). There are no true vipers in the United States. The pit-vipers include the rattlesnakes, moccasins, "fer-de-lance," and bushmaster (*see* Vipers).

The only poisonous snakes in the United States are the rattlesnakes, of which there are 16 species, including the pigmy rattlers, north of Mexico; the water moccasin; its near relative, the copperhead; and the coral snakes, with two species (*see* Copperhead; Moccasin; Rattlesnake). It is important to know them all, particularly the copperhead and moccasin, for they resemble many of the harmless

snakes. Such knowledge not only protects human beings from harm, but tends to stop the wholesale destruction "on suspicion" of all snakes, many of which are of great value to the farmer, as they eat up quantities of insects, rats, mice, gophers, prairie dogs, and other pests.

The coral snakes are among the prettiest of all reptiles. They are ringed with brilliant colors, and appear harmless and gentle. Yet they are of the same family as the deadly cobra, and their tiny fangs, which they sometimes use with treacherous swiftness, inject a poison of fatal strength. The two species in the United States are the "harlequin" and the "Sonora" coral snake, the former found throughout the South, the latter confined to Colorado and Arizona. They may be distinguished from certain harmless snakes of similar patterns by the fact that the colored rings are arranged in the following order: red, yellow, black, yellow, red. Even so, it is best not to place trust in a hasty identification.

THE HARMLESS COLORFUL GARTER SNAKE



The Garter Snakes are the most numerous and most widely distributed of all American snakes, being common in all sections except the arid western regions. Their favorite haunts are grassy meadows and the borders of streams.

The venoms found in poisonous snakes are usually clear yellowish liquids, which get their deadly power from certain highly complex chemicals of the proteid class. When the snake strikes its victim this poison usually enters the tissue immediately beneath the skin and from there is absorbed into the blood and distributed through the system. All snake poisons act principally upon the nerves with a paralyzing effect, beginning with weakness in the legs and arms, which quickly spreads to the entire body, followed by spasms, labored breathing, coma, and death.

The Poison of the Deadly Cobra

Cobra poison, which is considered the most deadly of all, creates at first a burning pain in the wound. One of its characteristic effects is to make the victim speechless after a few minutes. Rattlesnake poison, while less deadly, is more violent in its action upon the system, causing staggering fits, vomiting, swelling of the limbs, and acute spasms. There is danger that the person who survives the first effects of a rattlesnake bite may die weeks afterward from gangrene, which often sets in at the place where the poison entered the body.

In treating any snake bite the first thing to do is to tie a string or rope above the wound and twist it tightly with a stick. Then gash the wound freely to make it bleed. Thereafter, drain it by pressure or by means of suction cups at frequent intervals. The string or rope must not be left on for more than half an hour or gangrene will set in. Antitoxins or "antivenins," as they are called, have been produced which are useful to snake collectors and others who handle poisonous reptiles. They are injected into the blood like other serums (*see* Antitoxins). The effects of snake venom, however, are not all evil. It is collected by squeezing the poison glands of live snakes and is used in tiny quantities to relieve pain and treat such diseases as arthritis.

In addition to the highly poisonous snakes mentioned, there are about 300 species of "semi-poisonous" snakes, which, either because of the imperfect arrangement of their fangs or because of the weakness of their venom, are unable to do much harm to large creatures. Only two unimportant members of this group occur in the United States.

This leaves a large majority of perfectly harmless species, which are made to suffer for the sins of their venomous relatives. In many parts of the world certain of these snakes are regularly regarded as valuable household pets, being clean and quiet and ridding their adopted homes of mice and rats.

And Snakes Make Lovely Pets!

Most snakes, indeed, soon become accustomed to human society and are tame and docile in captivity. The western bull-snake, which sometimes attains a length of nine feet and is the largest North American snake, is the favorite of the circus "snake charmers"; if it is fed enough eggs and poultry, it good-naturedly permits itself to be handled in the most careless fashion. The racers, which include the indigo snake, the blacksnake, the coach-whip, and the blue racer, are other large snakes which thrive in man's neighborhood, and, if they can be kept out of the chicken coop, perform considerable service in protecting crops from rodents. The coach-whip is perhaps the speediest and most active of all snakes, darting over the rough ground almost as if it had wings.

The rat snakes or *colubers*, including the corn snake, the pilot blacksnake, the fox snake, the chicken snake, are even more deserving of man's protection, for they regularly dwell in fields of growing grain and exterminate countless numbers of small harmful creatures.

But the most unjustly persecuted of all are the innumerable varieties of garter snakes—those graceful, delicately striped creatures, whose only offense is that, like many others of the snake tribe, they give off when first captured an evil odor. But even this habit disappears in a few days. As they feed chiefly

on small frogs, toads, fish, and worms, they cannot be classed as useful; but they lend bright color to the life of the countryside. They are very prolific, a single mother producing from 25 to 75 young in a single season.

Harmless Snakes That Pretend to Be Bad

There are many harmless snakes that do everything in their power to imitate their poisonous brothers. The familiar hog-nosed snake is a good example. The cobra and the rattlesnake together cannot present a picture of such villainous ferocity as this small creature, which cannot even be induced to bite. It hisses, spreads out its neck, and darts its upturned nose so viciously in every direction that many people call it the "puff-adder" and are convinced of its venomous nature. Yet if you approach boldly, the hognose, instead of making good its bluff, will turn over on its back and pretend to be dead. The only way you can make it betray its sham is by placing it on its stomach, when it will roll over again on its back at once.

Many of the water snakes (genus *Natrix*), which frequent the borders of rivers, lakes, and swamps, are killed because they imitate the deadly moccasin. The bites of these harmless reptiles are often mistaken for moccasin or copperhead bites. Subsequently "cured" by popular or quack remedies, they are responsible for a dangerous amount of misinformation about the treatment for snake venoms.

The king snake belongs to a genus (*Lampropeltis*) ranging in size from 14 inches to 6 feet. The common king snake is a powerful creature from 4 to 5 feet long, marked with a striking pattern of yellow or white bands, arranged like a chain on a black background. This powerful reptile does not, as is sometimes said, actually hunt out poisonous snakes, but it gladly attacks any it may chance to meet. It coils itself quickly about its adversary and tightens its grip with such strength that the victim is soon strangled, and, if not too large, it is eaten. But the king snake's courage is after all not so great, for it is immune to snake poison.

Snakes belong to the suborder *Ophidia*. With the lizards (suborder *Lacertilia*) they form the order *Squamata* of the class *Reptilia* (*see* Lizards; Reptiles). In the older families, such as the boas, the skeleton shows traces of hind legs, which have been lost in the process of evolution. In this respect they show their close connection with the lizards, some of which, such as the "glass snake," have no external limbs.

Although snakes seem to hear very well, they have no external ears. Such hearing apparatus as they have is hidden beneath the skin. Their bodies are covered with even rows of scales. These scales are enlarged into fixed shields on their heads. In all but the true sea snakes, the scales of the abdomen are modified into narrow "scutes," each one reaching across the belly and overlapping its rear neighbor like a shingle on a roof. This arrangement takes the place of legs.

The majority of snakes lay eggs, which are whitish with a tough outer shell; but most of the vipers and all the sea snakes bring forth living young, as do also our common garter snakes. As soon as the young are born or hatched, they are able to shift for themselves. The poisonous varieties have fully developed fangs and venom sacks.

In cold countries snakes hibernate during the winter. All the members of the order are able to go an extraordinary length of time without food, and many live to a great age.

Snipe and Sandpipers. Long-legged, longbilled shore birds that pick their way daintily along the water's edge on sea, lake, or marsh are probably sandpipers or one of their close relatives.

Scientists group these birds in the family *Scolopacidae*. In addition to the many different kinds of sandpipers, the family includes the snipe, sanderling, knot, curlew, willet, yellowlegs, dowitcher, godwit, and woodcock (*see* Woodcock). Among the European species occasionally seen in the United States as rare stragglers are the ruff (the female is known as the reeve), dunlin, and whimbrel.

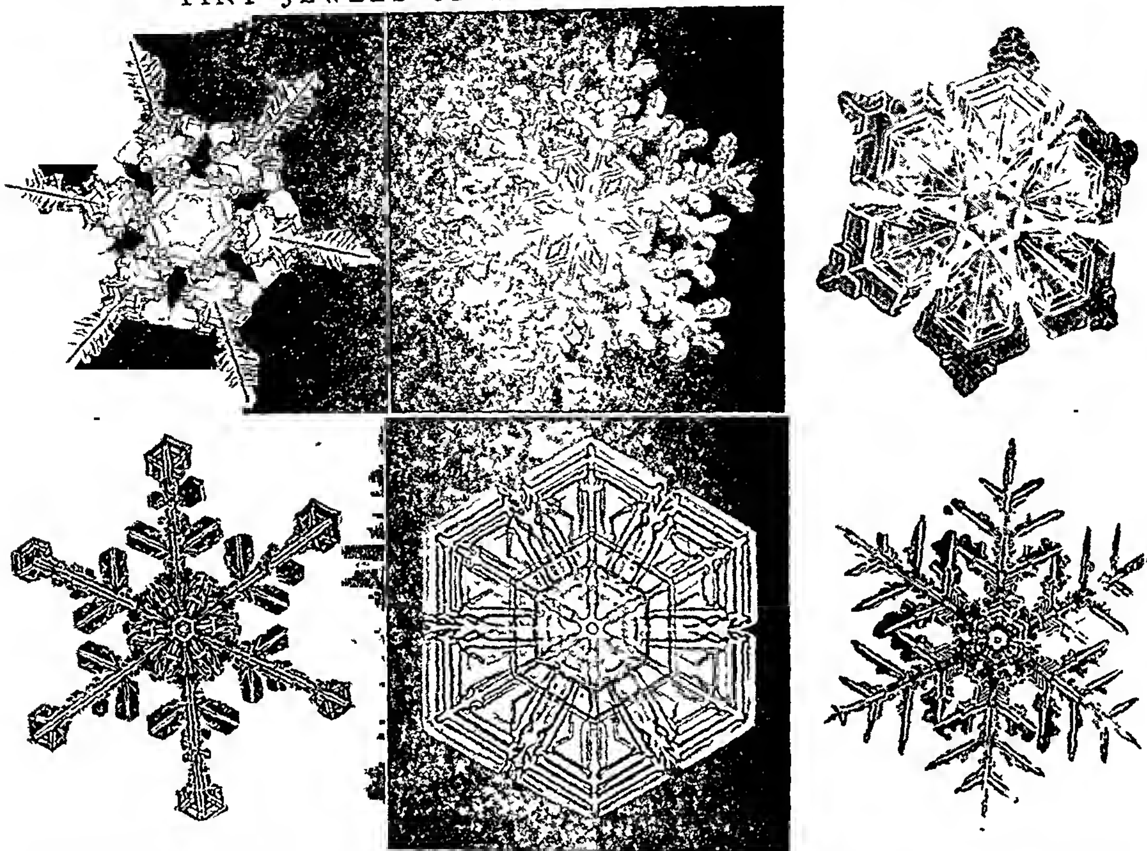
They are world-wide in distribution. Most of them nest in the northern parts of the Northern Hemisphere and winter in South America, Africa, and southern Asia. They are rarely found far from water. An exception is the upland plover (more properly called Bartramian sandpiper, for it is not a true plover). This bird nests on the prairies.

All of them are patterned in brown and white. Male and female look alike. The winter plumage differs from the summer. The spotted sandpiper, for example, loses its dark breast spots in the winter. The most colorful of the family are the knot (said to be named for King Canute of England) with a breast of robin red in the summer; the purple sandpiper, and the buff-breasted sandpiper. All of them lose their color in the winter. They vary in size from the long-billed curlew, which is two feet long, with a bill six inches long, to the least sandpiper, six inches long with a bill three fourths of an inch long.

The most familiar of the group is probably the little spotted sandpiper. It is abundant on seacoasts and inland lakes throughout North America. As it walks along the water's edge it teeters constantly. The Wilson's snipe, or jacksnipe, a marsh bird, is a popular target for hunters. The long-billed and the Hudsonian curlew are large handsome birds, with very long downward-curved bills. Their cousin, the Eskimo curlew, has joined the sad list of recently extinct birds. The last specimens were seen in 1926. Once very abundant, they were wiped out by hunters.

Snow. In all latitudes snow forms out of the moisture in the upper air. As it falls through the lower air it melts if the air is warm. Thus from the equator to latitude 30°, snow is almost unknown at sea level; from latitude 30° to about 40°, it is an occasional winter visitant; from about 40° to 75°, it is generally present during a longer or shorter period in winter; in latitudes above 75°, snow falls on perennial snow, where there is land. At the equator the snow line —the height above sea level at which snow does not

TINY JEWELS OF ICE WHICH WINTER BRINGS



Snow is really ice shaped into minute crystals. Often you will be able to catch single crystals in your hands and give them a quick study before they melt, but more often the flakes combine in groups before they reach the earth. Although they vary greatly in details, snow crystals all belong to the hexagonal system; that is, they all have six sides or angles.

melt—is about 17,000 feet above sea level. From the equator it descends to about 13,500 in latitude 30° and to about 1,000 feet in latitude 70°. In regions of perpetual snow, the weight of one snowfall on another may, on steep mountain slopes, produce a snow slide, or avalanche; on less steep slopes, the lower part of a snow field is changed to glacial ice (*see* Glacier).

One curious snow phenomenon is seen only in low latitudes where the tropical sun in some places sculptures the perennial snow of the mountains into fantastic colonnades so like processions of kneeling human figures that the South Americans call it the "snow of the penitents."

Because of the great amount of air it contains, snow is a poor conductor of heat. Eskimos and explorers in the Arctic regions sometimes build *igloos*, or huts, of snow blocks, which can be kept surprisingly warm in even the coldest weather. Where winters are severe, the presence of the snow blanket protects the dormant vegetation beneath from fatal cold and keeps in the heat rising from the warmer layers of earth below.

Snow consists of water crystals, though sometimes the snowflake is a shapeless woolly tuft or pellet composed of masses of the typical six-sided crystals. Probably no other substance crystallizes in such an infinite variety of beautiful forms as water. Some crystals are flat, or tabular, some are columnar needles, and some are compound structures. Variations of these three classes are endless. The pictures above show some of the beautiful forms that flat crystals take. Crystals formed in the low clouds are usually large and branching; those from the high clouds are small and compact. The western, southwestern, and northwestern segments of great snowstorms usually furnish the most perfect forms. Wilson Alwyn Bentley, the first man to photograph snow crystals, took pictures of more than a thousand different forms.

Snow comes from supercooled droplets of water held in clouds or in the upper air. These droplets have a temperature far below freezing, but they do not turn to snow until a nucleus on which the crystals can form is provided. This nucleus may be a bit of dust or matter such as snow from a higher level. Scientists now can produce snow by scattering Dry Ice (solid carbon dioxide) from an airplane into a cloud. Only a little Dry Ice is needed, for the first crystals formed act as nuclei for the rest.

Red, green, blue, and even black snow is occasionally seen in many parts of the world. The colors are due to the presence of innumerable tiny fungi or to dust collected by the snow as it falls through the air.

The HISTORY *of a* CAKE *of* SOAP

SOAP. "Cleanliness is next to godliness," we are often told, and true cleanliness would be next to impossible were it not for soap. It is also one of the best protections against germ infections. Indeed, soap has become an essential of civilization. Its scarcity is one of the hardships of war, when the soapmaking fats are diverted to the manufacture of explosives. People in war-stricken countries have paid fabulous prices for single cakes of soap.

Indispensable as soap is to us, it was absolutely unknown until about the beginning of the Christian Era. In earlier times people anointed their bodies with olive oil, and used juices and ashes of various plants and fuller's earth for cleansing purposes. Pliny, a Roman writer of the 1st century A.D., who makes the first reference to soap, speaks of two kinds, hard and soft, and mentions it as originally a Gallic invention "for giving a bright hue to the hair." In the ruins of the buried city of Pompeii a complete soap-making establishment was found, as well as some well-preserved cakes of the finished product that resembled closely the soap of today.

This lad is learning to use toilet soap to wash away playground grime. Laundry soap in the home or laundry washer helps keep his clothing clean. Americans use more than 25 pounds of soap a year for each person.

Nearly three billion pounds of soap are produced yearly in the United States, where the greatest progress in its manufacture has been made. The chief producing centers are in Indiana, Ohio, Illinois, New York, California, Pennsylvania, and Missouri. Especially fine soaps are made in France, where Marseilles has long been recognized as the center of the soap trade, a position originally achieved because of its command of the olive oil markets.

The Chemistry of Soap

Soap is made by the action of alkali on fats or oils. A simple experiment will show you how alkali acts on grease. Put a spoonful of washing (lump) soda with a little water in a greasy frying pan and boil the mixture. In a few minutes the soda and grease will have broken up and the particles will have united to form a thick soap, which can be washed out, leaving the frying pan clean.

Soap, to most of us, means a cleansing substance which makes a lather in soft water. A chemist, however, will tell you that soaps are metallic salts of certain fatty acids. Some of these salts—those of sodium, potassium, and ammonium—are cleansing agents soluble in water; others, such as the lead soap used in pharmacy as a plaster base, are insoluble and useless as cleansers. We are concerned here only with two of the cleansing soaps, the sodium and potassium soaps, and particularly the former. A potassium soap is soft soap. Hard soap is a sodium compound; the degree of hardness depends on the character of the fat. Most commercial soaps are sodium soaps.

The discovery of the Leblanc process for making soda from salt about 1791 (*see* Sodium) gave a great impetus to the soap-making industry of the early 19th century. It became organized on a scientific basis, however, only after the researches of the great French chemist Chevreul, published in 1823, showed the composition of animal fats (fatty acids in combination with glycerin) and the character of saponification (the substitution of the metal in the alkali for the glycerin in the fat). This is the essence of all soaps.

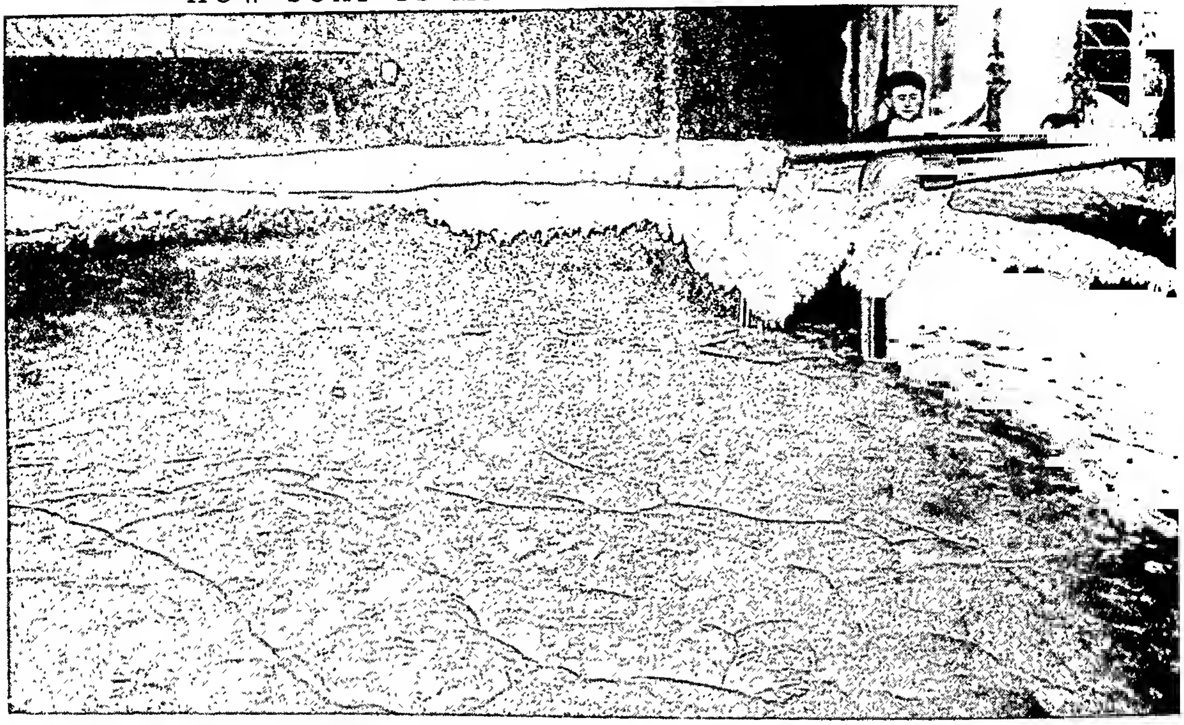
Now what happens when we wash our hands or clothing with soap? You know that our sweat glands are constantly giving off a certain amount of oil, which catches dust and dirt and soils our clothing. When soap is dissolved in water and rubbed on the hands or on soiled linen, it acts in two ways: First, it forms an *emulsion* with the oil, that is, a mixture in which the oil is held suspended in very fine particles, so that the oil can be washed out with the soap solution. Second, the very fine particles of soot and dust attach themselves to the tiny droplets of the soap solution, so they too can be washed out.

Plants that Act Like Soap

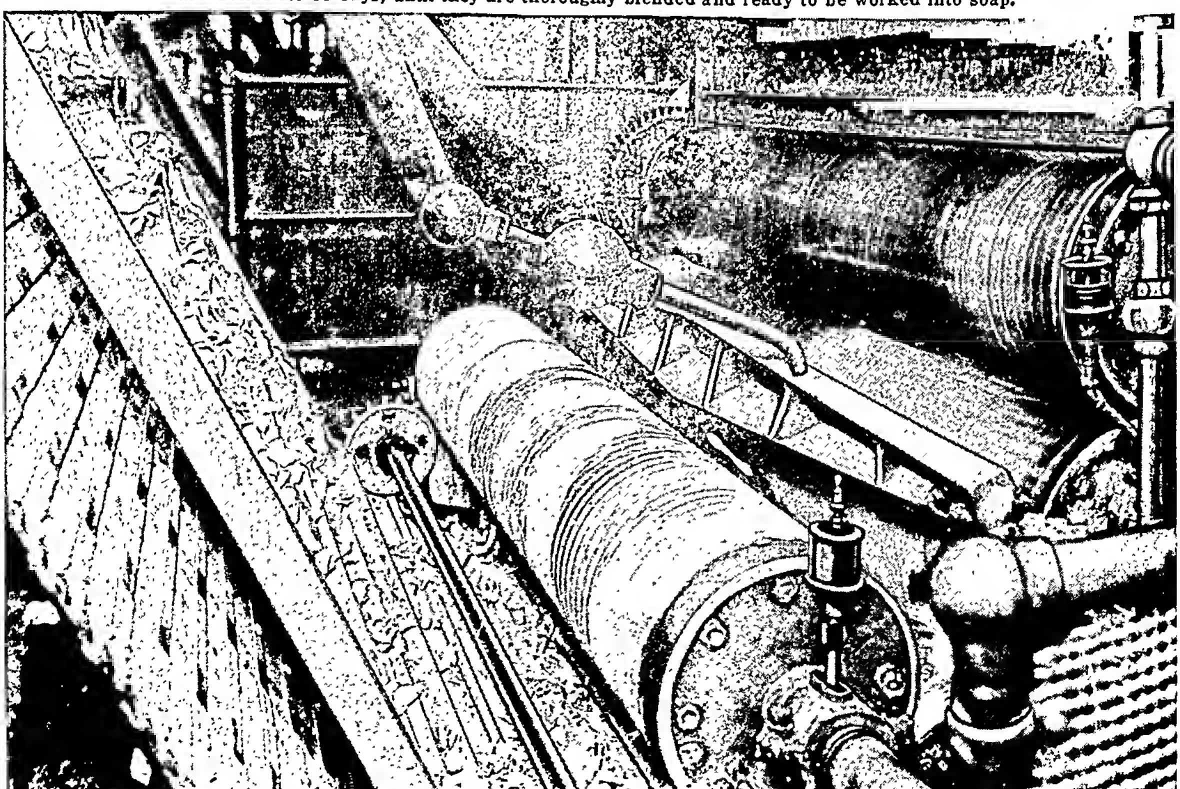
Certain plants, such as the common soapwort or "bouncing-bet" of the United States, contain a poisonous compound called saponin, which cleanses in much the same way as soap. In Chile and Peru the powdered bark of the soapbark tree (*Quillaja saponaria*) is used in washing fine fabrics.

Every household was its own soap factory in pioneer days. Our great-grandmothers used to save all the waste grease from their kitchens for "soap fat." For the saponifying alkali they used the lye obtained by leaching wood ashes—that is, pouring water through them to get a solution of potassium carbonate or

HOW SOAP IS MADE—BOILING AND DRYING



Here is the gigantic soap kettle in which the ingredients are boiled in a modern soap factory. And huge as it looks, you do not get a true idea of its real size, for this kettle is four stories deep and holds 275,000 pounds. It is heated by steam coils, and the ingredients are boiled for 11 days, until they are thoroughly blended and ready to be worked into soap.



After boiling in the kettles, the soap is allowed to cool somewhat and then is run through the rollers at the right. They are of granite and are chilled with water. They congeal the liquid soap and deliver it to the heated roller in the middle of the picture. This roller irons out the soap into chips and delivers the chips to the endless belt at the left, which carries the chips into the drier.

potash. At least once a year the accumulated soap fat was boiled up with the lye, usually in a huge kettle over an open fire in the back yard. The result was a yellowish soft soap. If the housewife wanted hard soap she "salted it out" with brine. The sodium in the salt and the potassium in the "soft soap" exchanged places. The resulting sodium compound rose to the top and cooled as a solid cake of hard soap.

Either vegetable or animal fats may be used. The vegetable fats used include coconut, palm, olive, cottonseed, and soybean oil. The ingredients in soap must "balance" exactly. An excess of fat would produce a greasy mass, useless for cleansing, and an excess of alkali would burn skin and rot fabrics.

Soapmaking in Modern Factories

In factories, soapmaking starts in big steel kettles that may hold from 125 to 175 tons. They are heated by steam coils. Inlet pipes pour in the ingredients, and a cone-shaped bottom allows drainage. First the fats are run in; then alkali is added. The alkali separates the fats into fatty acids and glycerin, then combines with the fatty acids, to make soap. The combining process is called *saponification*. In making laundry soaps a salt solution throws the glycerin to the bottom. In most higher-grade soaps more or less glycerin is left. Some soaps are made from free fatty acids without glycerin.

The soap is purified by several boilings for about 11 days, then left to cool. Then it is run into a *crutcher* and beaten smooth by paddles. Scent and coloring are added if desired. For laundry soap resin is added to promote lathering. Rosin colors the soap yellow. From the crutcher the soap goes into frames or molds. When the soap has hardened, the sides of the frame are stripped off. The soap blocks go into cutting machines to be divided into bars. The bars are dried, pressed into cakes, and wrapped.

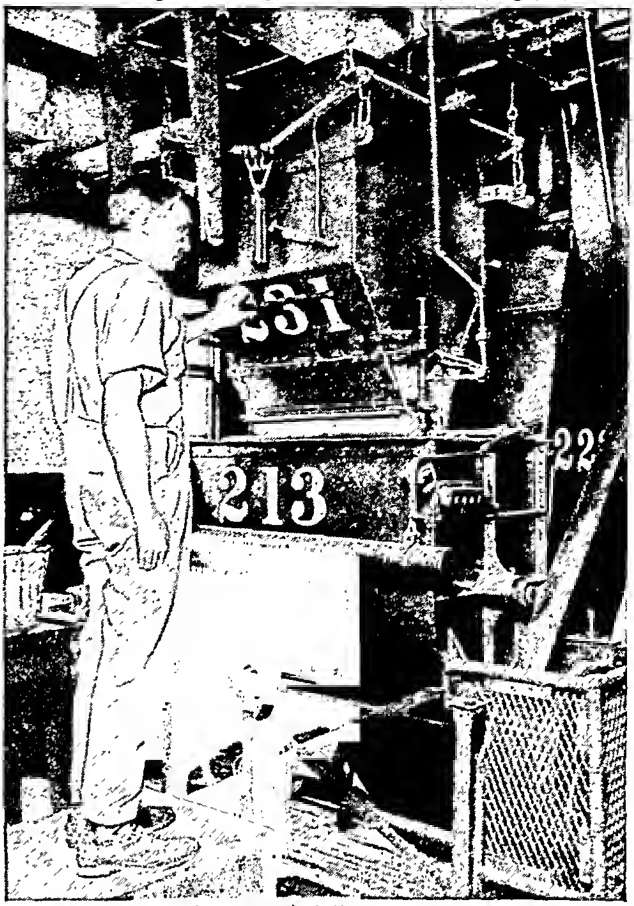
In 1948 a continuous process was introduced commercially. A mixture of fat and alkali enters a centrifuge whirling at 15,000 revolutions a minute. Saponification takes place in a few hours, and the pure soap is ready for cutting.

Different Kinds of Soaps

Toilet soaps are made in much the same way, but with fats of better quality. Instead of going through a crutcher, they are dried and sent to a mixer, or "mill," where perfumes and coloring matter are added.

Transparent soaps are prepared either by dissolving ordinary soap in alcohol or by leaving some glycerin in the soap. In the first process the alcohol solution is decanted and the alcohol distilled off. The residue is a thick transparent jelly, which dries as a clear solid. Glycerin soap consists of glycerin and soap in about equal parts. An excess of glycerin makes liquid soap. Scouring soaps contain abrasive material. Castile soap is made with olive oil; but the term may also mean any fine, mild soap made with another oil. For example, "coconut castile" is a toilet soap made with coconut oil. *Naphtha* soaps contain naphtha or kerosene for cutting heavy grease.

PERFUMING THE MIXTURE



Here a scale (numbered 231) delivers measured quantities of chips to a mixer (numbered 213), where the perfume is blended in. Afterward, the soap is *milled* with granite rollers, and then molded into bars and cakes.

Shaving creams are soft soaps made with caustic potash and a slight excess of stearic acid. The brushless type contains glycerin or similar agents. Saddle and harness soaps have a little wax, which remains on the leather when dried. Shoe polish has more wax, plus a dye to match the color of the leather.

Special Detergents and Wetting Agents

Soaps and other cleansing agents are often grouped as *detergents*. The term comes from the Latin *detergere*, meaning "to wipe off." Doctors use the term for mildly antiseptic soaps such as "green soap," made from potash alkali and linseed oil, and for various cleansers used on wounds and ulcers.

Ordinary soaps do not work well with sea water or "hard" water, which contains dissolved lime or magnesium salts. These salts may coagulate the soap and prevent it from loosening dirt and grease effectively. Soaps for use with hard water contain a *builder*, such as sodium silicate (water glass), various sodium phosphates, borax, or sodium carbonate. The builder transforms the dissolved salts, so they do not hinder the action of the soap. Many soap powders contain a builder. Salt water soap is made with coconut or palm oil, caustic soda, and a builder.

The most powerful cleansers are special *wetting agents*, products of modern synthetic chemistry, some-

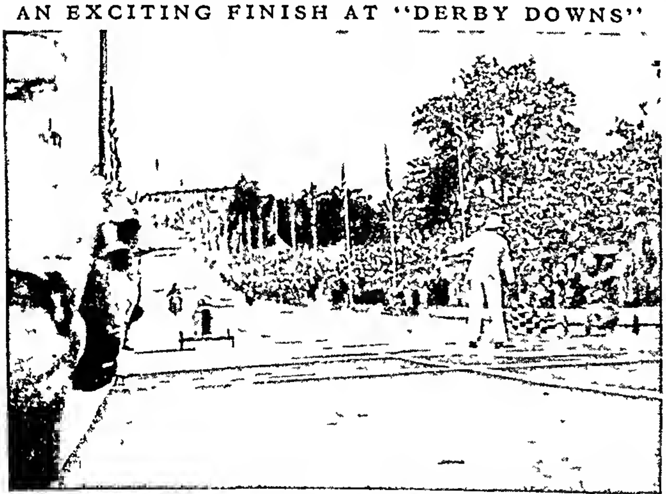
times called "soapless soaps." They have long chain-like molecules. One end of the chain consists of a water-soluble group or radical, and the other end of an oil-soluble group. Thus the molecules can act as links, bringing together substances that otherwise would not mix. When added to a liquid, they break down cohesion and surface tension within the liquid (*see* Liquid). Thus they can penetrate under all kinds of dirt. Ducks cannot swim in water containing a wetting agent. It penetrates the oily protection of their feathers. The ducks become soaking wet and sink. Special "no-rinse" laundry detergents hold the dirt in suspension in the washing water. Dirt and water leave together in the wringing process.

Wetting agents are now used in washing powders, shampoos, tooth dentifrices, and germicides. They also help make lubricating oils and dyes more penetrating.

SOAP BOX DERBY. A crowd of boys whooping in "soap box" coasters down a Dayton hill inspired one of the nation's outstanding amateur races. One day in 1933 a photographer for the Dayton *Daily News*, Myron E. Scott, watched the fun, then persuaded his newspaper to promote a citywide race. The next year he interested an automobile company and a number of newspapers in sponsoring a national competition.

More than 100,000 boys in the United States and Canada came to compete in the preliminaries for the annual All-American and International Soap Box Derby. The finals, held at "Derby Downs" in Akron, Ohio, attracted more than 100,000 spectators.

AN EXCITING FINISH AT "DERBY DOWNS"



Cheered by 100,000 enthusiastic spectators, two boys roll across the finish line at "Derby Downs." The course is a concrete hill, 1,100 feet long and 30 feet wide, with a 16 per cent grade.

The Derby was open to boys from 10 to 15 years of age. It encouraged not only sportsmanship but craftsmanship, for the racers had to be built by the boys themselves, and without a single bit of adult help except advice. These racers were gravity-propelled coasters, and had no engine or motor of any sort. The course was a rather steep hill 1,100 feet long, down which the racers rolled at a top speed of about 20 miles an hour. Each year more skillful craftsmanship went into the winning cars. Wheel alignment, bearing adjustment, springing, weight distribution, tire pressure, and an efficient steering system were the most important factors. Success depended chiefly on the ability of the car to roll with a minimum of friction in the moving parts. Total cost of materials was limited to $10. The only parts permitted to be purchased ready-made were wheels, tires, bearings, axle rods, steering wheel and steering shaft, springs, and the hardware used in the construction of frame and body. No welding, brazing, soldering, or other processes beyond the average boy's capacity were allowed

Newspapers promoted the local races and sent their winners to Akron. An automobile manufacturer paid the boys' expenses in Akron and awarded prizes. A four-year university scholarship went to the champion. Suggestions for building cars and the rules governing races and equipment were obtainable from local newspapers or from the Chevrolet Motor Division, General Motors Sales Corporation, Detroit.

SOAP BUBBLES. Pretty things to amuse children, but not worth the attention of a serious student—that is probably what you think of soap bubbles. What would you say of a man who at 40, nearly blind and dependent upon the eyes of a daughter-in-law, made brilliant scientific discoveries by studying bubbles? A Belgian physicist, Joseph A. F. Plateau (1801–1883), did that, and enriched our knowledge of surface tension and other forces within liquids. His work, like Newton's two centuries before, proved that much may be learned from bubbles (*see* Newton).

Why is a bubble round? For the same reason that a raindrop is round—because the "skin" formed on its surface by surface tension (*see* Liquids) tends to make the surface as small as possible. Since a sphere has the smallest surface for a given volume, raindrops, dewdrops, and drops of molten lead always tend to form into spheres, except as they may be forced out of shape by the pressure of the air through which they are falling.

A soap bubble differs from a raindrop in having two surfaces—one inside, one out—and therefore having twice as much surface tension It contracts until stopped by pressure from the contained air. Since gravity continually drains water from the top of the bubble, the upper wall becomes thin and tends to break. Bubbles that will last a long time, however, may be made from the following mixture: Dissolve thoroughly one ounce of pure Castile or palm oil soap shavings in eight ounces of distilled water or rain water, then stir in briskly four ounces of pure glycerin. Let the mixture stand until a layer of clear liquid gathers at the bottom of the container Siphon this off for use. For the best results the solution should be kept free from dust. It can be stored in a well-corked bottle.

What causes the beautiful play of colors in a soap bubble? The inner and outer surfaces act as mirrors; the space between varies in depth and acts as a prism. Thus, light passing between these surfaces is reflected,

refracted, and subjected to interference (*see* Light). When interference blocks one color, we see the complementary color. Constant changes in the thickness of the bubble cause the shimmer of color.

Why does a bubble rise at first? Your breath is warm, and thus lighter than cold air. A cold bubble will float on the surface of a gas heavier than air. It floats until the heavy gas seeps into the bubble.

SOCIALISM—*A* PLAN *for* ORGANIZING *Human* SOCIETY

SOCIALISM. One plan of government is called Socialism. It is based on the theory that all key businesses and industries should be owned and operated by the workers and the state.

Socialism arose from the Industrial Revolution. In the early 1800's the invention of the steam engine changed manufacturing and transportation in Europe and the United States. Factories sprang up to manufacture goods with machinery driven by steam power. Railroads were built to carry goods and passengers.

The article on Industrial Revolution explains how an ever-increasing number of people went to work in the new factories and for the railroads. Instead of owning their own shops and tools, they used the employer's equipment and were paid in wages. It became customary to call these workers *labor*.

The owners of the factories and railroads were wealthy men or stockholders who invested in the enterprises. The owners came to be called *capitalists* and their financial interest was called *capital*. The *management* of the business was handled by the owner himself or by directors and officers (*see* Corporations).

The Problem of Capital-Labor Relations

Most of the factories, railroads, and other enterprises provided their owners with a comfortable living. But the wages received by labor were usually pitiably low. Many men, women, and children worked long hours under unsanitary and unsafe conditions (*see* Industrial Revolution; Mines).

Many businessmen and 19th-century economists believed that conditions would improve as the new system grew and production increased. They thought business would thrive best if everyone was free to earn what he could. They also maintained that men work best when they receive rewards for extra efforts. And they urged that such *incentives* should be higher wages for labor and greater profits for capital.

In general usage, these principles came to be grouped together under the name *capitalism*. This viewpoint has also been called "laissez faire," (let people do what they please). Another term is *free enterprise*. Other men, however, denied the claims of the capitalism theory. They offered another plan for organizing human society called *Socialism*.

Socialists believe that the profit motive has a degrading effect upon men. According to their view, competition solely for profit produces selfish rivalry among capitalists. They say that capitalists tend to hold wages as low as possible, thus keeping workers in poverty and misery. Socialists maintain that workers should first be assured a comfortable living. Then they can be inspired to better efforts by incentives other than money. Among these are higher rank and the respect given for worthy achievement.

Socialists also assert that many advances are suppressed because they do not promise profit. They say the remedy lies in having the government own all key enterprises. This will curb or eliminate the profit motive and enable management to operate the enterprises for the good of all.

Many Meanings of the Word "Socialism"

The word "socialism" seems to have been first used in a journal of a coöperative society in 1827. Since then the word has had many meanings. Both extreme revolutionaries and moderate reformers have called themselves Socialists.

But today extreme revolutionaries, who believe workers should seize control of business and the government by violence, have come to be called Communists (*see* Communism). On the other hand, moderate Socialists believe in winning political power by legal means and then using it within the framework of established governments. They advocate extensive programs for social security (insurance and pensions) and heavy taxation of the well to do for the benefit of the poor. This policy has been called *evolutionary* Socialism. (*See also* Sociology.)

Early "Utopian" Socialists

Outstanding pioneers of the socialist theory were the Comte de Saint-Simon and François Fourier in France and Robert Owen in Great Britain. These men have been called *utopian* Socialists, from the title of the book 'Utopia' by Sir Thomas More (1478–1535) which described an ideal society.

Saint-Simon (1760–1825) believed in a system of centralized control of business and enterprise by industrial leaders and men of science. Everyone was to contribute according to his ability and be rewarded according to his works.

Saint-Simon's countryman Fourier (1772–1837) favored small groups of congenial individuals, living and working together for the good of all. He called such a communal group a *phalanstery*. Several experiments along these lines were carried out in the United States. The most famous was Brook Farm (1841–47) in Massachusetts.

Most of these adventures in communal living collapsed. People did not live together unselfishly as expected. The few successful exceptions were held together by some binding tie of religious faith.

Robert Owen (1771–1858) was a wealthy manufacturer and philanthropist. Like Fourier, he favored the experimental small community. He began among the workers in cotton mills which he owned in New Lanark, Scotland. He tried to prove that he could pay good wages and provide good working conditions and still earn a profit. For his 2,000 employees he built a model community with schools and coöperative stores.

Having succeeded in this venture he proposed to establish "villages of cooperation" throughout Great Britain. In them the poor could combine farming with industry and exchange products among themselves. But "Owenism" aroused strong opposition, so he went to the United States and founded a cooperative community at New Harmony, Ind. Dissension among the leaders wrecked the experiment (1825–29). Owen returned to Scotland and continued to insist that society causes evil behavior when it encourages competition among men.

Marx and "Scientific" Socialism (Communism)

By far the most important figure in the history of Socialism was Karl Marx (1818–83). He was a German Jew who lived much of his life in political exile in England. Marx contributed what had been lacking in the works of pioneer Socialists. He developed a consistent system of economic and political theory which, he claimed, amounted to an exact science. Marx and his collaborator, Friedrich Engels, presented their views in crisp, popular form in the 'Communist Manifesto', published in 1848. Later Marx elaborated his views in his massive work 'Das Kapital' (Capital).

FOUNDER OF "SCIENTIFIC SOCIALISM"

Karl Marx spent most of his life in exile in London. Jenny was the oldest of his three grown daughters.

Marx used the term "communist" to distinguish his views from those of the utopian Socialists. They had believed in voluntary cooperative living. Marx thought the interests of capital and labor were utterly irreconcilable. Labor would be oppressed and all but starved as capital continued to take (expropriate) most of the margin between cost and selling price for profit. Meanwhile capitalists would weaken each other through destructive competition, and they would drive their countries into wars to win new markets. Sooner or later the workers would have to revolt and seize control of government and enterprises in order to improve their lot.

In 1864 Marx and others formed the International Workingmen's Association in an effort to unite the Socialist groups in various countries. But Marx's imperious temperament and his intolerance of opposition led to many quarrels. The Association dissolved in 1876. Later it was remembered as the First International. (*See also* Communism; Marx.)

Socialism as a Political Force

Marx's views had tremendous influence on Socialist thinking. But more than half a century passed before the violent Communist view was separated clearly from more moderate beliefs and policies. In all countries except Russia, however, the trend was to drop methods of conspiracy and armed insurrection

One reason was that Marx's forecast of increasing misery and oppression was not coming true. Instead, there was progress in education, in social welfare, and in humanitarian legislation. Another reason lay in the progress which Socialism made as a political force. There were no Socialist governments anywhere in Europe at the time; but Socialist parties and trade unions were developing ability to influence government actions.

A Socialist Second International was organized in 1889. Its congresses hoped to build a united class feeling among the workers in all countries and to use this to prevent war. If hostilities threatened, the workers might prevent the struggle by refusing to serve as soldiers or to make war supplies.

Among the leaders (aside from Marx) during this period were Louis Blanc (1811-82), the pioneer of political Socialism in France, and Ferdinand Lassalle (1825–64), organizer of social democracy in Germany. Wilhelm Liebknecht (1826–1900) and August Bebel (1840–1913) followed Lassalle as German leaders. Another German, Eduard Bernstein (1850–1932), led a "revisionist" movement. The aim of his "evolutionary socialism" was to soften the extreme revolutionary dogmas of Marx. But his ideas were officially censured by congresses of the German Social Democratic party.

Socialism in the United States

In 1848 Germany suppressed several revolutionary movements, and many of the defeated leaders sought refuge in the United States. They brought ideas of Socialism with them. But neither they nor their successors ever attracted enough voters to achieve any great political strength.

In America they found no large class of people who felt that there was no hope for better days under free enterprise. Until about 1900, anyone who wanted to farm could get free land in the West. Most workers who had ability could improve their positions until they won comfortable incomes or even wealth And continual gains in productivity brought a steadily rising standard of living.

In some cities, immigrants found themselves compelled to work for low wages and live under miserable conditions. Miners and workers in lumber camps also suffered exploitation. The Industrial Workers of the World (I.W.W.), formed in 1905, urged violent revo-

lutions. But they never achieved political importance (*see* Labor). For the most part, however, workers saw more hope in the growing power of trade unions than they did in Socialism. One of the great trade-union leaders was Samuel Gompers (*see* Gompers).

In 1874 a workingmen's party was formed. Soon it adopted the name of Socialist Labor party. A group split off in 1899, and in 1901 it formed the Socialist party. Among its best-known leaders were Eugene V. Debs (1855–1926), Victor L. Berger (1860–1929), Morris Hillquit (1869–1933), and after about 1928 Norman Thomas (*see* Labor Parties).

Socialism mustered its greatest show of political strength in the United States in 1912. In the presidential election of that year Eugene V. Debs received about 6 per cent of the popular vote as a candidate for president. The party has continued in politics since then but with little effect upon events.

Two parties with some elements of Socialism in their programs, the Labor party and the Liberal party, exist in New York State. The Progressive party, which was founded in 1948, urged nationalization of basic industries.

World War I and the Schism in Socialism

The first World War brought a clear separation between Marxism and other Socialist views. The hope that international Socialism could stop a war proved vain. In each nation Socialists responded to mobilization orders like the rest of their countrymen.

The international Socialist movement was split three ways by the war. First, majority groups in the Socialist parties of continental Europe and in the British Labor party supported their governments. Second, minority groups offered some passive opposition to the war effort, partly on Marxist, partly on pacifist, grounds.

A third trend was led by the Russian, Nikolai Lenin. He and his followers succeeded in establishing a Marxist (Communist) government in Russia (*see* Lenin; Russia). They also set up a Third International, with headquarters in Moscow.

These developments created a permanent schism in Socialism. The Communist parties proclaimed the dictatorship of the proletariat and aimed at creating Communist régimes in all countries. The Socialist parties identified themselves more closely with constitutional democracy. The separation served gradually to clear moderate (evolutionary) Socialists of earlier suspicions that they were violent revolutionaries.

Socialism between World Wars

The first World War accustomed people to rationing, to managed currencies, and to state intervention in economic life on a scale unprecedented in former wars. Afterward, Socialism made important political gains, notably in the Scandinavian countries, in Austria, and in Czechoslovakia. Socialist tendencies came into power through elections of Labor party governments in New Zealand in 1935 and in Australia in 1929–31 and again in 1941. In Great Britain the Labor party, devoted to a British type of Socialism, displaced the Liberal party as the principal opposition to the Conservatives. There were Labor governments, the first in British history, in 1924 and in 1929–31.

The political advance of Socialism on the continent of Europe was held back by two postwar developments. The Communists attracted much of the working-class vote which had formerly supported the Socialists. And the rise to power of Fascism in Italy (1922), National Socialism in Germany (1933), and other authoritarian régimes in eastern Europe and Spain drove Socialism underground.

Curiously enough, although Hitler and Mussolini persecuted Socialists out of legal political existence, they adopted certain policies which might be called socialistic. Such measures were the imposition of far-reaching state controls in finance, trade, and production, with a view to channeling output along desired lines and averting unemployment. Hitler called his organization the National Socialist party.

World War II and Socialism

After the second World War, conditions seemed to favor the advance of Socialism in Europe. Coalition governments with Socialists and Communists were set up immediately to rule France, Italy, and Belgium. Socialists figured importantly in the governments of the Netherlands, Austria, and the Scandinavian countries.

New régimes in Eastern Europe, in Poland, Rumania, Czechoslovakia, Hungary, and Yugoslavia, were also organized nominally under the leadership of "People's Liberation Fronts." They were dominated by Communists, but Socialists were included. Great Britain, for the first time, gave the Labor party a substantial majority in parliament in the election of July 1945.

Socialist Origins of the British Labor Party

The British Labor party was founded in 1900, under the name of the Labor Representation Committee. One spearhead for its creation had been the Fabian Society, a group of moderate evolutionary Socialists. Among its leaders were George Bernard Shaw, Sidney and Beatrice Webb, and Ramsay MacDonald. Another spearhead was the Independent Labor party, founded in 1893 by a group of trade-unionists. James Keir Hardie was the outstanding figure here.

The British Labor party has differed somewhat from the continental Socialist parties. Most of its members belong through their trade unions. Party and trade-union leadership are interlocked. There is also a close working alliance between the Labor party and the British coöperative movement.

The Labor party has never been antireligious or antimonarchical, and it has never followed a rigidly Marxian theory of class struggle and revolution. Communists are barred from membership, and there have never been more than a few Communists among about six hundred members of the British House of Commons.

When the Labor party of Britain came into power in 1945, it faced by far the greatest opportunity in history to prove what merits there might be in Socialism. Other Socialist governments had either been the leading party in a coalition government or had held power in much smaller countries.

The Labor party followed the established lines of evolutionary Socialist theory. The cornerstone of the program was *nationalization* of important enterprises, such as coal mining. Details of the program are given in the article on English History.

Voters Render Decisions in 1950–51

By 1950, however, the outlook for Socialism had become much less bright. In Eastern Europe the countries behind the iron curtain had become out-and-out Communist dictatorships. In Western Europe, Catholic parties replaced the Socialists as government leaders in one country after another. The British Labor party won a general election in 1950 by a bare margin, and then in 1951 lost to the Conservative party. Meanwhile in 1949 Australia and New Zealand had voted out their Socialist-dominated governments.

These setbacks seemed keyed to the extent or lack of progress made in recovering from the effects of the war. Australia and New Zealand had been content with their governments for many years because the countries seemed to be getting ahead. By 1949 the voters believed this was no longer true. On the continent of Europe, coalitions with Communists all but blocked national recovery. The Communists remained true to their Marxian principles. They did not help to promote recovery. Instead they created dissension preparatory to revolution. Large-scale American loans and aid helped achieve such progress as was made.

American aid also greatly bolstered the British economy. Great Britain seemed unable to produce enough out of its own resources of materials, labor, and capital for a comfortable living and favorable trade balance. Even with American aid, it had "austerity living."

The test of the few postwar years was not conclusive. Any form of government would have had difficulty making progress under the existing conditions. Against the claims of Socialism stood the fact that it was no magic cure for economic and social ills.

What of the Future?

These mixed results suggest some of the difficulties in judging the future of Socialism. Most democratic governments also have clouded the issue. For decades, non-Socialist parties in these governments have included in their programs measures which once would have been widely condemned as "socialistic." This was particularly true of the New Deal administrations of Franklin D. Roosevelt in the United States.

The Conservative party showed this tendency in the British elections of 1950–51. Instead of urging a wholesale return to former practices of free enterprise, the Conservatives endorsed many of the aims of the Labor party. They promised to administer these measures more efficiently and economically.

The issues between Socialists and non-Socialists in many cases have become questions of method and degree, not head-on collisions of utterly opposed viewpoints. Such a blending seems characteristic of democratic government. Most political parties take what promises best results from various schools of thought. They do not give strict support to any one program.

SOCIAL SECURITY. Many working people have small incomes and can save very little. Their money is soon gone if they become sick or lose their jobs. Often they have little saved for their old age. To help these people many countries have set up systems of government aid called *social security*. This aid usually includes several forms of social insurance and public assistance to the needy.

Social insurance works like private insurance. It spreads risks and costs among a large number of people (*see* Insurance). It differs from private insurance chiefly in being compulsory. The government raises funds by taxation to pay the benefits of both social insurance and public assistance.

Social security as a responsibility of government is relatively recent; but the idea is not new. In the Middle Ages, the craft guilds dispensed benefits for sickness and death. Later, trade unions provided some relief for their members. But in time of stress most wage earners had to fall back on charity (*see* Poor Relief). France set up a voluntary unemployment insurance system in 1850. In 1880 England passed the Employers' Liability Act (*see* Employers' Liability). In 1883 Germany made accident insurance compulsory and soon it added sickness insurance and old-age benefits. Compulsory unemployment insurance was first adopted by England in 1911.

In the United States, high-wage standards and the tradition of individualism delayed development of social security. Not until 1911 was the first workmen's compensation law enacted. The first government old-age measure was enacted by Alaska in 1915 (*see* Pensions). Between 1923 and 1928 nine states passed laws permitting counties to give old-age pensions. In 1929 New York established a state system. Many states followed in the next few years.

Private and community relief organizations lacked funds during the long depression that began in 1929. In 1935 Congress passed a program, called the Social Security Act, and enlarged it in 1939 and 1950. The act provides: (1) old-age and survivors insurance, (2) unemployment insurance, and (3) grants to states to aid their public assistance programs. The Social Security Board, in the Department of Health, Education, and Welfare, administers the act.

Old-Age and Survivors Insurance. Taxes on employees and employers provide the funds for this insurance. By the 1935 act each employee was taxed 1 per cent on a yearly income up to $3,000 and the employer 1 per cent. The expanded act of Aug. 28, 1950, raised the taxable income to $3,600. Both taxes were to rise gradually to $3\frac{1}{4}$ per cent in 1970. On Jan. 1, 1954, they rose from $1\frac{1}{2}$ to 2 per cent. The government holds reserve funds in trust.

The Social Security Board issues to each insured person a Social Security card with his registration number. When he reaches 65 years of age and retires, he receives monthly payments. His wife or his widow also receives monthly payments at 65, and allowances are given for his dependent children. Lump-sum payments are made when an insured worker dies and

leaves no survivor eligible for immediate monthly payments. In 1950 coverage was extended to many workers not previously eligible. For a single person the minimum monthly payment is $25 and the maximum, $85. For pensioners with dependents the minimum monthly payment is $45 and the maximum, $168.90. Pensions for railroad workers were set up before the Social Security Act was passed; they are administered under a separate agency called the Railroad Retirement Board.

Unemployment Insurance. The states and territories administer unemployment insurance. All of them now have plans approved by the Social Security Board. In most states employers pay the entire cost. The 1935 act called for a federal tax of 3 per cent on their payrolls. Against this the employer received a credit of 2.7 per cent for what he paid into his state employment system. Employers who have a small turnover of labor get a "merit rating," which reduces their payments. The unemployed worker receives a weekly payment after a waiting period if no suitable job has been offered to him. The state law determines how much he receives and for how many weeks.

Public Assistance. States that have public assistance programs approved by the Social Security Board receive federal aid. The Federal government pays about one-half the state's expenditures for the needy aged, the needy blind, and dependent children. It also aids state programs for vocational rehabilitation.

Different Forms of Health Insurance

The United States has no system of public health insurance. But counties, cities, and states all provide a good deal of care from public funds. The Federal government gives financial aid to states for hospitals and general health service. It also provides medical services for the armed forces and veterans. Many Americans carry *group health insurance* or *group hospital insurance* with private companies.

In 1948 the British government established the Health Service Act. The law provides free medical treatment for all and disability benefits for workers. The cost is paid by health insurance premiums paid by workers, by contributions of employers, and by the national treasury. This act was part of a "cradle to grave" social security program drawn up by Sir William Beveridge in 1944. It calls for insurance benefits for sickness, unemployment, retirement, maternity, and widowhood.

Soviet Russia has a complete system of socialized medicine. The state provides all medical services.

SOCIAL SETTLEMENTS. Amid the grime of slums in many cities stands a friendly building called a social settlement. Day and night, people from near-by tenements gather there for education and recreation.

Social settlements arose to relieve the distress brought about by the rise of crowded industrial centers (*see* Industrial Revolution). With the growth of factories, thousands of people poured into cities. Herded together in slums, they lived in filth and disease, with little chance to better themselves. Unrest and crime flourished in these "blighted districts."

To help these people, a group of young graduates of Oxford and Cambridge universities decided to live and work with the poor in the East End of London. In 1884 they founded the first social settlement. This was Toynbee Hall, named for Arnold Toynbee, who had inspired the movement. Many other settlements have since been established in England and elsewhere. The first in the United States was New York City's Neighborhood Guild, started in 1886 and later called the University Settlement. In 1889 Jane Addams and Ellen Gates Starr founded Hull House in Chicago (*see* Addams). Others included Henry Street Settlement in New York, South End House in Boston, and Telegraph Hill in San Francisco.

Most of the men and women who take up settlement work are college students or graduates. Many of them live in the settlement buildings, so that they can make friends with the people of the neighborhood and learn their problems at first hand.

Day and evening classes are held in English, citizenship, manual training, dressmaking, pottery, music, and many other subjects. For the children and young people, there are reading and game rooms, a gymnasium, a playground, and often a theater. There are clubs too for debating, dramatics, athletics, and civic activities. Many settlements also have day nurseries, employment bureaus, and child-behavior clinics.

Social settlements have helped to bring about many social reforms. They aided labor organizations to get laws passed against sweat shops and child labor. Their pioneer work in training young people for trades and homemaking led many public-school systems to provide similar opportunities. They have had a big part in fostering visiting-nurse services, sanitary-housing laws, and slum clearance, and in bringing about the creation of the federal Children's Bureau.

LUNCH AT NEIGHBORHOOD HOUSE

These youngsters are enjoying a midmorning snack of crackers and milk at the Neighborhood House nursery in Washington, D. C. Many social settlements provide a nursery where working mothers can leave their children during the day.

How SOCIAL STUDIES *Help Make* GOOD CITIZENS

SOCIAL STUDIES. Building good citizens is the first aim of our public school system. All school subjects and experiences play a part in this process, but it is the special task of the social studies. These subjects deal with human relationships. (*See* Citizenship.)

To be a good citizen one should know and be able to use many facts and skills. He should know how various peoples, with different resources and customs, live together in peace and happiness. He should understand the history of his own people and the principles by which they live. He should be able to comprehend the problems of his people and be willing and able to help solve these problems. He should have high moral values and be loyal to the democratic traditions. Most of all he should be a well-adjusted individual, mature in thinking and able to get along with others in his family, his community, his nation, and his world. It is the aim of the social studies to train young citizens with these qualifications.

The social studies program extends through the schools from the study of family, school, and community life in lower elementary grades through the social sciences offered in college. Visits to classrooms at different levels show the wide range of content and methods which make up this large and important field of study. Some sample visits follow.

Around the walls of one classroom hang pictures showing scenes and events linked with the life of George Washington. Here are pictures of his birthplace, of his home, Mount Vernon, of a young George Washington surveying a plot of land, of a mature Washington at Valley Forge and Yorktown; of an older Washington making his Farewell Address as president. Maps show the 13 original colonies and the Revolutionary War campaigns. Replicas of the Declaration of Independence and the Constitution are displayed. On tables lie relics of colonial times and models of colonial clothing, furniture, travel equipment, and the like, created by the pupils.

The pupils are discussing events and conditions during the life of Washington, relating them to the American Revolution, and learning the principles on which the nation was founded. They read their textbooks, encyclopedias, and other reference works for background material.

This is a class in American history, one subject in the field of the social studies. The pupils are learning facts about the origins of the nation and the basic principles of democracy developed by the founding fathers. The students are learning to understand the basic values that will help them make judgments and take action as American citizens.

Learning about Other Lands and Peoples

In another classroom a large map of the world hangs on a wall and beside it is a map of Europe. Nearby stands a globe and about the room are various items from Norway: manufactured goods, handicrafts, clothing, and art objects. Pictures around the room show different aspects of life in Norway. On a table lies a moulded relief map of the Scandinavian Peninsula.

These city boys and girls are gaining facts and understandings about rural life from a field trip to a farm. Social studies classes make wide use of community resources.

The Middle Ages come to life for these pupils as they meet a knight in armor in a museum collection. These two pictures are from the Connecticut State Board of Education.

The class has assembled to hear reports of various committees appointed earlier to carry out special projects. One has studied the land, its resources and climate; others have studied ways of making a living, customs and cultures, art, and relationships between Norway and the United States. The committees have finished their studies and now they are presenting their reports to the class. Everyone discusses the reports and their meanings and relationships. The re-

port on the land and resources is tied in with those on making a living, on population and emigration, and on the culture and customs of the people.

This class is studying geography—another of the social studies. Geography helps present a picture of how other people live and what social, economic, and cultural forces influence them. This, coupled with a knowledge of the past history of the country (from another social study—world history), gives citizens a basis on which to build opinions about their world neighbors. (*See* Geography; World History.)

How the Courts Function

A third class is discussing the American judicial system. They have visited their county courthouse, listened to cases being tried, and talked with court officials. They are discussing the rights of the defendant and how he is protected by the Constitution of the United States, by state constitutions, and by law. The relationship between county, state, and federal courts is discussed, and one student reports on the evolution of the system of justice in the United States (*see* Courts of Justice). Questions are raised regarding the court system under Communism. Since class discussion leaves several points unsettled, the pupils make arrangements to invite a lawyer to meet with the class and answer questions.

This is a class in government, civics, or political science (*see* Government; Political Science). During the year it will study the functioning of the legislative and executive branches as well as the judicial branch of the government (*see* United States Government; Congress; State Governments). As they gather facts about their local, state, and federal governments, the students learn the role of the citizen and his responsibility for good government. They come to appreciate the philosophy and values of the American system.

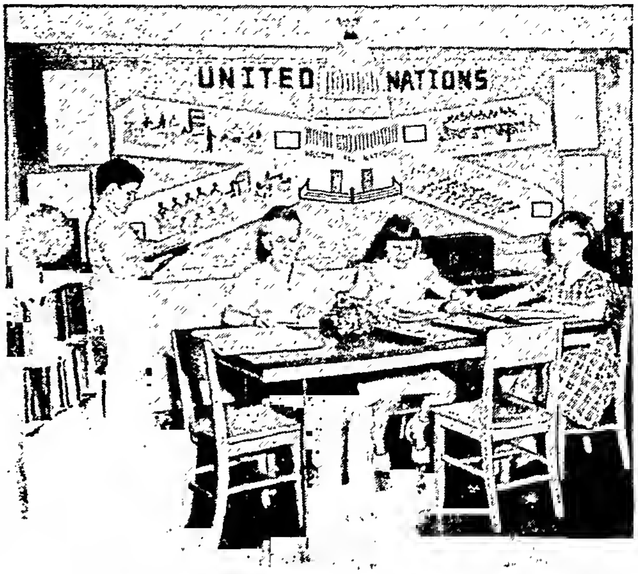
Studying a Community Problem

A fourth class has just returned from a trip into the community where they have observed slum, or substandard housing, conditions. They have interviewed tenants, landlords, and responsible city officials. The students have many questions to ask. What caused this part of the town to run down? How do the residents make a living? Does the area meet the requirements of the building code? Can the city condemn substandard dwellings? If they were torn down, where would the residents move? What is the effect of these housing conditions on health? On juvenile delinquency and adult law breaking? What can be done to improve housing in such neighborhoods? Should the government pay for slum-clearance projects and provide low-cost housing? Would it be better for private investors and builders to undertake such projects?

Pupils and teacher decide that more information and insight are needed to answer certain questions. Topics are selected for further study and discussion and reading lists are prepared (*see* Housing).

This is a class in community problems, part of the high-school social studies program. Students are engaged in a type of research they will need as good

COMMITTEE RESEARCH ON UNITED NATIONS



This picture from the Madison, Wis., public schools shows a committee studying books and periodicals as they prepare a report for a current problems class. A radio is ready for newscasts.

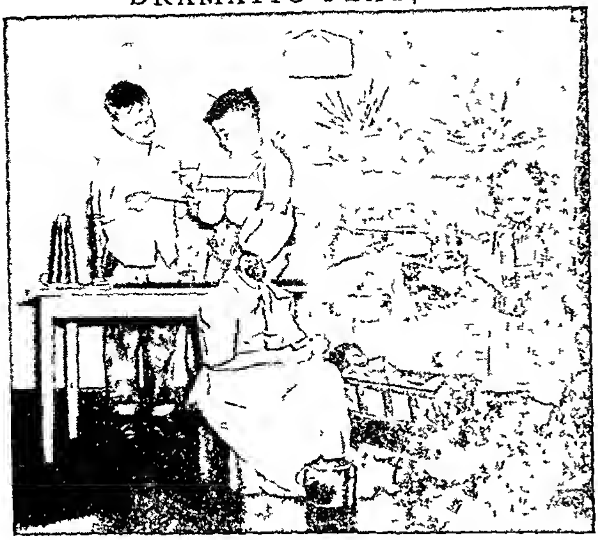
citizens. They are gathering facts through observation, interviews, reading, and other research. To understand the problem, it is necessary to go into the *history* of the community, to see what *geographic* forces have affected the area, to study the *economic* factors involved, to analyze the role of *government*, to draw on *sociology* and *social psychology* (*see* Economics; Sociology). The students find that all these divisions of the social studies contribute to their thinking about the problem. They see that a complex problem cannot be approached from a single point of view. A real study calls for an understanding of the interrelationships between the different branches of the social studies. They learn that this is true of practically all the problems the nation faces. Single answers to controversial questions are not often found.

Approaching an International Problem

A fifth classroom is darkened and the students are viewing a film on the United Nations. The class is starting a unit on "Roads to World Peace." As the film is concluded, hands are raised by eager questioners. Why did the United States join the United Nations? Why are some countries not members? Does the organization have authority over the United States and other member nations? How can it accomplish its objectives if it does not have power to force member countries to abide by its decisions? What has the United Nations done toward achieving world peace? What are some of the earlier efforts to achieve peace through international collaboration? Is Russia sabotaging the efforts of the United Nations? What are the activities of the Specialized Agencies?

This class is studying an international problem of concern to all mankind—again part of the upper-grade social studies program. There is quick agreement on the aims: world peace and security and the preservation of the nation and its democratic heritage. The

DRAMATIC PLAY, MODEL MAKING, AND MAP MAKING



These pupils in Glencoe, Ill., are co-operating in activities that give meaning to pioneer life. The girls, in costume, are carding wool at a painted hearth. The boys work at a wagon model.

Here two high-school students are at work on a model of a contour map of Italy (for methods, *see* Maps). This activity requires extensive research, pupil-teacher planning, and manual skill

problems arise in connection with the means to achieve these goals. Final answers cannot be given to many questions, but the students are learning how to think about problems, how to gather facts, evaluate information, reach conclusions, and decide on courses of action. Again they need knowledge from the various branches of the social studies and an understanding of the interrelationships between them. They find that it is difficult to think clearly about such complex and controversial issues and even harder to decide on courses of action, yet they realize that these difficult tasks are demanded of the good citizen.

What Are the Social Studies?

The social studies deal with human life—past and present; with people's basic needs and with the activities through which they meet their needs, with the institutions they have developed, with the forces affecting human behavior. The term "social studies" is a name of a field of study, just as "mathematics" names a field that includes arithmetic, algebra, geometry, and trigonometry. The term does not mean a particular organization of subjects, a point of view, a social, economic, or political doctrine, a philosophy, or a method of teaching.

The common divisions of the social studies found in the schools are: history, government or civics, geography, economics, sociology, and problems of democracy. These subjects are developed independently of one another and may be taught independently. In the elementary schools today, however, the subjects tend to be united or integrated, and courses are sometimes designated simply as social studies. At higher grade levels, where more technical and advanced concepts are met, the tendency is to list the separate divisions as courses. In the last years of high school where problem courses are offered, as well as in courses on contemporary affairs, an effort is made to bring knowledge from all fields to bear on the problem under study. There are a great variety of ways in which the social studies curriculum may be organized, although the basic objectives are the same.

The Objectives of the Social Studies

One objective of the social studies is to present knowledge from the various subject-matter divisions, adapted to each grade level and to the maturity of the pupil. The social studies aim to develop understandings and attitudes about the nation and the world, which are based on information. Without knowledge, understanding and intelligent action are impossible.

A second objective is to develop the will and ability to act—to develop responsible citizens who know how to carry out action programs in a democracy. The social studies program tries to make the individual citizen see that it does make a difference what he thinks and does about affairs in his home, his community, his state, his nation, and the world. The means of communication, participation, and action need to be clear to every citizen.

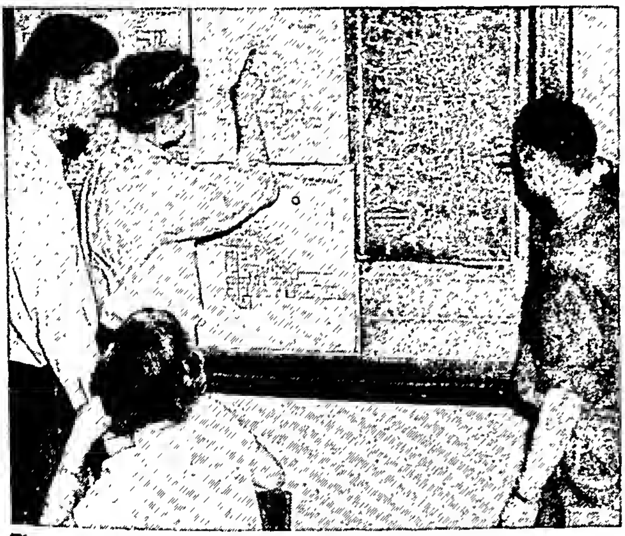
A third objective is the growth and development of basic skills related to the content and study of the social studies. These include:

I. Skills in the scientific method of inquiry
   a. The ability to locate and gather information
   b. The ability to evaluate and organize information
   c. The ability to think critically and solve problems
   d. The ability to reach conclusions and formulate possible courses of action

II. Social skills
   a. The ability to participate in group undertakings
   b. Skill in getting along with others
   c. Skill in observation
   d. Skill in assuming responsibility and exercising leadership

PREPARING FOR A CITIZEN'S DUTIES

Here pupils in a civics class at Madison, Wis., are engaging in an art activity to help them visualize the three branches of the federal government and the functions of each branch.



These Chicago high-school seniors will soon be voters. Here they are locating their home ward and precinct in a civics class, preparing to play the good citizen's role at election time.

III. "Tool" skills
   a. The ability to interpret maps and globes
   b. The ability to interpret material in graphic form
   c. The development of a sense of time and chronology

The social studies also join in the general school task of developing skills in reading, listening, speaking, and writing. All these skills are essential in the development of an enlightened citizenry.

A fourth objective of the social studies is the development of a basic set of values or ideals that will guide the conduct of the individual as choices are made and courses of action are determined. The home, the school, and the church all have a definite responsibility for teaching these values, and all should work together for their development.

A fifth objective is the development of individuals who are well adjusted to society—citizens who are able to adapt themselves to changing conditions. While the social studies generally deal with the nature of society, they are also concerned with the development of individuals, their emotional and intellectual adjustment to society. The personal problems of youth are dealt with to help students make adjustments in day-to-day situations.

Social Studies Content and Methods

The content, or subject matter, taught in the social studies is selected from the *social sciences,* which, at the college level, are the scholarly fields of teaching and research dealing with human relations and human group life. Teachers and curriculum committees assemble for elementary- and secondary-school courses materials from those broad fields selected for (1) the interests and maturity of the pupils; (2) the teachability of the ideas and facts; and (3) the contribution which the ideas and facts can make in the social and civic development of the boys and girls. The basic objectives furnish guides as to what is to be selected. Textbooks offer some methods and content but many other references and teaching aids are needed. Teachers meet together locally and in national professional organizations to exchange information and give mutual assistance. The task of the teacher has become increasingly difficult with the passing years because society has grown more complex while the school curriculum affords no more time in which to teach.

Materials of instruction are chosen to present the subject matter in an interesting, carefully considered way. Typical classes use textbooks, reference books, encyclopedias, newspapers, periodicals, films, filmstrips, recordings, maps, globes, charts, models, and museum collections. Field trips are a common and useful means to give pupils a chance to observe and collect data not found in the classroom. Many different teaching methods are successfully used. There is no such thing as a social studies method. Reading, research, group activities, panel discussions, class reports, speakers, pupil-teaching planning, field trips, collections, audio-visual materials, testing, model making, art, dramatization, interviews, and the use of the community as a laboratory are a few of the methods used to interest and instruct children. Achieving the goals of the social studies calls for a teacher with scholarship, initiative, ingenuity, and with the qualities for leadership.

Where current problems are studied, the teacher is faced with the special difficulty of handling controversial issues. The right of the pupil to learn what he needs to know places on the teacher the responsibility to teach about controversial issues. If a curriculum does not deal with important issues of the day, the school is failing in its responsibility. The treatment of such issues should be at the maturity level of the pupil and in accord with high professional standards. Final answers are not reached, but knowledge about the problem and skills in problem solving are emphasized. (*See* Reference-Outline and Bibliography for Sociology.)

SOCIOLOGY—*The* STUDY *of Human* SOCIETY

SOCIOLOGY. Most people spend their entire lives as members of one group or another. They are born into the family group. Later they get together to study in school, to work, to play, to worship, or in some instances to commit crime or to make war.

This tendency to form groups lies at the very foundation of human society. If we want to know why people act as they do, we must understand how the grouping process operates. Such studies of group behavior form the subject matter of the science called *sociology*. Its chief function is to study the "rules" that govern group living. Sociologists want to learn how these rules originated, how they operate, why some change, and why others die out and disappear.

What Is a "Society"?

In order to study group behavior, a sociologist must decide what makes up a group. A crowd at a baseball game is a group but it exists as a group only as long as the game lasts. Such temporary groupings deserve study because they illustrate human behavior. But it is more important to understand the forces which hold groups together for a lifetime or influence people for hundreds of years. Sociologists use several tests for detecting these forces.

First, they look for the original tendency to get together and form a group. A primary impulse is the love of companionship. A group formed for such a reason is the family or the people who live in a town.

Second, the sociologist looks for bonds of sentiment, feeling, or belief which help to hold the group together. A religious belief is one example; loyalty to a nation is another. Social habits and courtesies also help to define a group. American men shake hands with each other when they meet. The Ainu of Japan places his hands together in a gesture of greeting (for picture, *see* Japan). Such differences may seem trivial, but people tend to associate with those who have the same social habits as themselves.

A third and most important test is the exchange of services and benefits between the members of a group. In a country like the United States or Canada, some people do the farming, others work in factories, and so on. By specializing in this way, each one can produce a surplus of some commodity or service. This increases production and benefits the group as a whole. Thus mutual exchange acts powerfully to hold the group together. The ancient Greek philosopher Plato considered this division of labor and interdependence of a group the very foundation of human society.

A group which is held together more or less permanently by ties of the sort described is often called a *society*. The word comes from the Latin *socius*, meaning "a companion." Some sociologists believe that a group can only be called a society if it can perpetuate itself—that is, pass on its customs and ties of feeling and interdependence to the next generation.

Culture and Institutions

The sum of all the rules, characteristic activities, and methods of group life is frequently called human *culture*. Each group which can be described as a society has its own distinguishing culture.

Various aspects of a group's culture tend to fall into fixed patterns, just as individuals form habits. Those habitual ways of thinking about and doing things in groups are called *institutions*. A social institution is a group custom, such as marriage, property, education, government, or religion.

Once an institution is established people are usually reluctant to change it. But new situations arise constantly, and institutions must be adapted to suit the changed conditions.

During the Middle Ages in Europe, good farming land was the most important form of wealth, and the distinguishing mark of a nobleman was his ownership of land. Manufacturing, trade, and loaning money were considered relatively ignoble occupations. Today this belief has changed. The manufacturer, the merchant, and the banker are as respected as the landlord. Sociology studies and tries to explain such changes.

Rational and Irrational Conduct

Men like to consider themselves intelligent beings. But if they always acted intelligently, they would plan their cultures and institutions to work to the best advantage. Occasionally, men do plan important institutions deliberately. After the American Revolution, an assemblage of leading men planned a new government and wrote a constitution for it. When the 13 colonies adopted the United States Constitution to govern themselves, they entered into a *social contract*, or agreement.

Most social institutions, however, are not the product of any contract or agreement, as the French philosopher Rousseau thought they were. They were worked out gradually, and all too often by bitter experience, as men learned by trial and error how to adjust their different aims and get along together. Frequently such institutions are colored and shaped by hatreds, mistaken thinking, and class, race, or religious prejudice. For many centuries the nobility of Europe believed that warfare and even individual fighting (in tournaments and duels) was the most dignified of all occupations. They looked with contempt upon peasants, merchants, and laborers.

For years men felt compelled to fight duels to maintain their honor. Only in the 1800's did they come to realize that dueling was a foolish and destructive way to settle quarrels. For centuries, many women made themselves uncomfortable and often injured their health by wearing corsets that were too tight. Only in the present century did they adopt more natural styles. Thus sociologists find that a new generation often accepts the culture it inherits without questioning it.

A sociologist also learns that many people have customs which appear to be grotesque, barbarous, or worse. Why, for example, do boys of Australian native tribes have their teeth filed to sharp points during their initiation into tribal membership? Why do some

primitive tribes practise head-hunting or cannibalism? Even the most civilized peoples have some beliefs and customs not based in fact. They cling to irrational beliefs which we call "superstitions."

The sociologist must study fashions and fads. These show how people copy new practises, habits, or costumes when they seem interesting or effective. This tendency to "follow the leader" is a powerful force in shaping group behavior.

Sociologists must consider all traits of human nature and look for irrational as well as rational reasons for group conduct. And they must realize that men are stirred to action by emotions and prejudice just as often as they are by "rules of reason."

Sociology and Other Sciences

Since sociologists study all important forms of human group behavior, their field is vast. Usually each important aspect is also the subject of a separate science. The relations between sociology and these other sciences are often vague and hard to explain. It would be reasonably near the truth to say that each science studies activities and phenomena in order to understand procedures and perhaps develop improvements. Bankers and economists do this when they study the money system of a country and suggest laws to improve the use and control of money and credit. A sociologist might study the same facts in order to learn how the people's use of money and ideas about it have influenced group behavior.

Sociology uses the findings of *psychology* to help understand the operations of the human mind. It depends upon *history* for many records of past social groups and also for special methods of studying those records. *Archeology* aids sociology by uncovering the story of peoples and their ways of living thousands and even tens of thousands of years before any written records had been invented.

One controlling feature in all records of the past is the fact that men depend to a great extent upon the earth for food, shelter, raw materials, and recreation. This relationship between man and his physical environment is sometimes called *anthropogeography.* Studies in this field include such problems as the effect of climate, the shape of the land, and the availability of natural products.

From all these studies the sociologist develops the story of how man has gradually freed himself from domination by his environment. At the same time he was learning to use and shape it for his own purposes. Steps in this progress have been the discovery of fire, the invention of pottery, domestication of animals, smelting of metals, and the development of transportation and communication (*see* Civilization).

Part of this record is the story of how men gradually improve their ways of thinking and acting about such problems. Most students of the past agree that the earliest men thought that everything in nature was controlled by various spirits and gods. There was a spirit for rain, another for sunshine, and so on. To gain favorable conditions, men tried to influence spirits with incantations and sacrifices (*see* Magic).

Thousands of years passed before men shook off this faith in magic and learned to use their own powers of intelligence in dealing with nature and producing what they needed. An important part of this development has been the growth of exact study and experiment. This special approach to problems is called *science* or "the scientific method" (*see* Science).

Studying Social Problems of Today

In its studies of group behavior, sociology must consider how the group does its work, how it governs itself, and its standards and rules of conduct. Considered as separate topics, these inquiries form the subject matter of *economics, political science,* and *ethics.* Sociology draws together the results of studies in these separate fields to give understanding of the group as a whole.

Social anthropology, ethnology, and *ethnography* are terms used to indicate branches of science which study the factor of race in human culture (*see* Races of Mankind). But these differences in skin coloring, head form, or hair texture cause people to think, believe, and act in characteristic ways. Therefore sociology must consider these physical aspects.

Sociology is linked with biology, economics, and other sciences in the study of *vital statistics.* Such studies consider fluctuations in the population, such as birth rate, marriage rate, death rate, and immigration (*see* Biometry). Some sociologists consider these facts to be the very core of the science of society. They provide connecting links between human beliefs, human heredity, and the physical environment.

As a part of such studies, sociology must understand how societies maintain social *control* of their members. Such inquiries consider how government, religion, the schools, family discipline, and public opinion, all combine to restrain individuals and make them obey the group's rules of approved conduct.

Attempts to Solve Social Problems

It is only natural to seek remedies for social problems. Such studies are often called *applied* sociology. They consider such problems as crime, poverty, war, ignorance, industrial maladjustment and conflict, immigration, race prejudice, leisure, and eugenics.

An important portion of applied sociology is the efforts made by trained *social workers* to achieve improvements for individuals, families, and communities. These workers apply their training in sociology to helping people solve their social problems and achieve satisfactory adjustment to their environment. Social workers also find employment in such activities as poor relief, social settlements, pensions, and social security (*see* articles on these subjects). A tireless pioneer in settlement work was Jane Addams, who founded Hull House in Chicago (*see* Addams).

New Ways of Studying Old Facts

Sociology is sometimes considered the youngest of the social studies. But as far back as we know, thinking men have studied social problems, the nature of man, and the origin and working of human society. Plato and other Greeks understood something about division of labor, eugenics, and social control through

education. The Hebrew prophets, particularly Amos, proclaimed a better social order. St. Paul taught through his concept of the mystic body, or union of Christian believers, that society is a reality. Through the centuries thinkers such as Sir Thomas More and Thomas Hobbes delved deeply into the nature of society and social man.

It was not until the 18th century that scholars in England, France, Germany, and Italy came close to what we think of as *social science.* The French Revolution, the Industrial Revolution, new discoveries in physics, chemistry, and biology, and later Charles Darwin's theory of evolution gave impetus to social studies. (*See also* Social Studies; Evolution).

Some Famous Sociologists

Toward the middle of the 19th century the French philosopher Auguste Comte applied the name "sociology" to studies aimed to draw together knowledge from various sciences to give an understanding of human society. One of his important working principles was his doctrine of *Positivism.* He believed that science should be built up by using nothing but "positives." This meant using those items of knowledge and understanding about natural phenomena which could be comprehended as working together exactly and invariably, like the parts of a machine.

Many scholars have opposed this view strongly. They believe that human actions and behavior include something more than machinelike responses to natural stimuli. But regardless of what the truth may be, Comte's views kindled a keen desire to understand group behavior more exactly and to work out sharper understanding of social institutions, investigative methods, and problems.

Herbert Spencer, John Stuart Mill, Leonard T. Hobhouse, and Edward A. Westermarck in England, Émile Durkheim and Gabriel de Tarde in France, Albert E. Schäffle in Germany; Lester F. Ward, William G. Sumner, Franklin H. Giddings, and Edward A. Ross in America are others who contributed largely to building up the science of sociology in its earlier days. It is now taught in most American colleges and in representative universities all over the world.

Sociology is still a young science, but it has influenced modern views on economics, history, law, political science, ethics, education, and religion. It has established facts which may be of great value in creating a better social order. While its first aim remains to know the facts about social life, its great service will be, as Comte taught, to promote human progress and a more rational society.

REFERENCE-OUTLINE FOR STUDY OF SOCIOLOGY

THE NATURE OF MAN

I. Man's origin and antiquity M-63, C-325, F-209
" Individual differences I-113-14
III. Influen... of heredity H-343-8, E-452
IV. Influence of e...nvironment H-348, E-452
V. Man's social natu...re S-220: his social heritage E-239-41; need for econon...ic co-operation E-222
VI. Biometry B-154-5

THE DEVELOPME...T OF SOCIETY

I. Primitive isolation: indepe...ndent struggle against nature C-325; unsettled life M-...63
II. Beginnings of progress and inve...ntions
  A. Early inventions I-199-200
    1. Use of fire F-73, M-63, pict...ure C-325
    2. Weapons for hunting a...nd defense: stone weapons and the Stone Age M-69, S-401-2; bow and arrow A-302-3, M-66
  B. Beginnings of social, or gro...up, life
    1. Foundation of the home F-18-18*b*, M-66
    2. Division of labor: men as hunters and warriors, women as home managers M-66
    3. Neighbors help and p...rotect each other S-220
  C. Types of primitive homes S-143-4
    1. Cave dwellings C-158, ...pictures M-64, 67
    2. Lake dwellings L-87, ...M-66, pictures M-68, S-144*a*, C-326
III. Foundations of civilization. S...ee also the Reference-Outlines for Ancient History an...d World History
  A. Simple arts and crafts M-...3: invention of pottery M-66, picture C-325
  B. Education by word of mout...h *(tradition)* E-241
  C. Domestication of animals C-3...25
  D. Beginnings of agriculture C-325, A-57-8, S-144
  E. Benefits of agriculture and domesticated animals
    1. Division of labor between farmers and craftsmen E-242, M-69, A-57
    2. Nomadic ways of life M-245, M-69, S-144, I-106*a-b*
IV. Effects of commerce T-164-5
  A. Beginnings A-57, C-326
  B. Rise of cities C-324, C-326: as market places (fairs) F-11-12; as dwelling places of craftsmen G-228
  C. Development of transportation
    1. Beasts of burden, wagons, and other vehicles T-170*d*
    2. Establishment of trade routes T-164-5
    3. Boats, ships, and navigation B-214, S-149-50, N-78-80
V. Rise of class distinctions G-145: slavery and serfdom S-194-5; the caste system I-58
VI. Rise of political organizations G-145
VII. Invention of writing and its effects. See also the Reference-Outline for Ancient History
  A. First written decrees and records W-310, C-326, E-240
  B. Development of positive law L-139
  C. Beginnings of formal education E-241
VIII. Growth of nations and nationalism G-145: city-states C-324
  A. Geographic influences
    1. Favorable soil and climate: Mesopotamia M-174-5; Egypt E-270; China C-259-61
    2. Harbors and trade routes T-164-6: Phoenicians P-204-5; Greeks G-189
    3. Rivers R-155-7

B. Racial influences
1. Migrations of vigorous peoples into more favorable environments M-245-6, B-23-4: Romans R-180
2. Military enterprise and leadership: Rome R-186; Macedonia under Alexander A-147-9

C. Religious influences: Jewish J-351-4; Christian C-301-4, J-339-40; Mohammedan M-329-32

D. Conflicts between nations
1. Causes: economic E-208, N-121, H-445-7, S-244; religious differences E-432; ambitious leaders (Napoleon) N-6-11
2. Efforts to settle international disputes by peaceful methods P-101: arbitration A-294-5; treaties T-177-8; international law I-189-91; League of Nations L-142; United Nations U-240-43 (Korea K-66)

Note: For a detailed study of the social influences that contributed to the rise and development of each of the great nations of antiquity, see the Reference-Outline for Ancient History. For any leading modern nation, see the Reference-Outline for that nation and the Reference-Outline for World History.

IX. Social influence of inventions I-199
A. Gunpowder helps to abolish feudalism G-232
B. Magnetic compass extends navigation C-427: new lands discovered A-187; contacts between peoples increased C-328
C. Invention of printing makes general education possible P-414*c-d*, E-240
D. The steam engine ushers in the Industrial Revolution I-132. See also the Reference-Outline for Industrial Revolution
E. Extension of the use of machinery M-13-14
F. Electric power appears E-289, E-309-10
G. Use of power gives more production and leisure P-403, L-158-62

SOCIAL INSTITUTIONS AND GROUP ACTIVITIES

I. The family, clans, and tribes F-18*a-b*
A. Marriage customs M-100-100*b*, F-16-17
B. Meeting child needs C-239-48: baby care B-2-4
C. Early training determines character and habits C-239-48, H-240: personality P-159*b*
D. Safety S-7-8. See also the Reference-Outline for Safety Education

II. The school S-57: for detailed study, see the Reference-Outline for Education

III. The church C-301-4, R-101

IV. The government G-144-6: for detailed study, see the Reference-Outline for Political Science
A. The spread of democracy D-63-7
B. The struggle for individual freedom I-115-17

V. Publicity: newspapers and magazines N-186-92, M-29-31; radio R-49-51; television T-50-2, 55; advertising and propaganda A-23-7, C-424*e-h*

VI. Social welfare work F-248-51: Florence Nightingale N-236; Clara Barton B-61; Wilfred Grenfell G-215; Martha Berry B-132; Albert Schweitzer S-59
A. For children F-249, 251: child labor laws C-249; juvenile courts J-368
B. For mothers: mothers' pensions F-251
C. For the poor and disabled: pensions P-140-1; education of the blind B-206-7; education of the deaf D-25; poor relief P-368-9; employers' liability E-341; Salvation Army S-33-5
D. For victims of disasters: Red Cross R-87*b*
E. For immigrants: Americanization A-217
F. The Negro problem in the United States N-107-9 George Washington Carver C-130; Booker T. Washington W-15
G. Social settlements S-218*a*: Jane Addams A-17
H. Prisons and punishments P-414*d*-416

VII. Foundations and charities F-248-51

VIII. Other social organizations
A. Patriotic societies P-98, A-223
B. Fraternal groups F-283, K-57: Moose and Elks (Fact-Index)
C. For young people J-368*a-b*: Y.M.C.A. Y-342; Y.W.C.A. Y-343; Boy Scouts B-273-8; Girl Scouts G-113-15; Camp Fire Girls C-54-5; 4-H Clubs F-252-252*b*; Junior Red Cross R-87*b*-88
D. Women's clubs W-183
E. Parent-Teacher Associations P-80
F. Labor organizations L-69-75

SOCIAL BELIEFS AND CUSTOMS

I. Magic and witchcraft M-33-40, W-179-80

II. Mythology M-475-8, outline M-478-9

III. Folklore F-193-208, S-408-23

IV. Ethics E-400

V. Costume and adornment D-144-51: jewelry J-346-50; tattooing T-23; armor A-376-7, K-55-7; uniforms U-234-9

VI. Social rank and precedence: decorations and titles of honor D-38-43; etiquette E-404-11

VII. Origin of personal names N-2*a*-3: nicknames N-235

VIII. Amusements V-421-32: hobbies H-387-401
A. Games for children G-8-8*f*
B. Athletic games: baseball B-63-72; basketball B-75-6; bowling B-266; boxing B-267-72; cricket C-511-12; curling C-530; football F-226-34; fencing F-50-2; golf G-136-8; handball H-256-7; hockey H-402; lacrosse L-82-4; polo P-364-5; rowing B-215; softball B-72; tennis T-70-2; water polo P-364; wrestling W-305-7
C. Sports and pastimes: boating B-214-19; camping C-56-63; canoeing C-113-14; swimming S-471-3; winter sports W-157-60
D. Nonathletic games: billiards B-144; cards C-121-2; checkers C-205-6; chess C-224-6; croquet and roque C-518
E. Theatrical entertainment T-110, 112-15: ballet B-28-28*d*; circus C-310-18; magic M-37-40; motion pictures M-407-34; puppets and marionettes P-439-42; opera O-388-98
F. Dancing D-14-14*m*: folk dancing F-192*a-d*

Note: For additional material in the field of social studies, see the Reference-Outlines for Citizenship; Clothing; Communication; Food; Home Economics and Management; Shelter and Housing; and Transportation.

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SOCRATES (*sŏk'ra-tēz*) (470?–399 B.C.). The most familiar figure on the streets of Athens near the end of the 5th century B.C. was an awkward man with a squat figure. He had a short neck, a bald head, a thick upturned nose, and round prominent eyes. He wore a single rough woolen garment at all seasons and went barefoot.

Now and then he would stop some richly dressed, solemn Athenian and ask him a simple question or two. The man would perhaps reply with an air of haughty wisdom, as if it were really beneath his dignity to hold discussion with so uncouth a questioner. Presently as a crowd gathered, the rich Athenian would discover that his grotesque adversary was making him seem absurd by his shrewd queries and would depart in high anger.

The barefooted speaker was the great Socrates, the wisest philosopher of his time, whose words changed the whole course of human thought. Today he is ranked as one of the greatest moral teachers that ever lived. Despite his appearance, even the beauty-loving Greeks of his day could not resist the fascination of his speech. The young and aristocratic military genius Alcibiades said of him, "His nature is so beautiful, golden, divine, and wonderful within that everything he commands surely ought to be obeyed even like the voice of a god."

Socrates was born in the outskirts of Athens about 470 B.C. He studied sculpture, his father's profession, but soon abandoned this work to "seek truth" in his own way. His habits were so frugal and his constitution so hardy that he needed only the bare necessities of life, and he was free to devote his time to things other than making money.

Socrates did not know the meaning of fatigue. Once the word passed around that he had been standing in one spot since early morning thinking on some deep problem. The people gathered about to see how long he would remain there. They had to bring out their beds to rest, for Socrates did not move from the spot until the following morning. Then he greeted the sunrise with a smile and moved quietly away.

For all his eccentricities, he was far from being abnormal or unbalanced. He fought like a lion in battle and was commended for bravery on the field of Potidaea (432 B.C.). He was the most sociable of men, delighting in banquets at the houses of his friends. There he would exchange jokes or talk the profoundest wisdom with equal pleasure.

Socrates' wife Xantippe was notorious in Athens for her sharp tongue and evil temper; but it must be said for her that her husband's unconventional manner of life must certainly have been exasperating to a careful housewife. The sage once jokingly explained his marriage by saying: "As I intended to associate with all kinds of people, I thought nothing they could do would disturb me, once I had accustomed myself to bear the disposition of Xantippe."

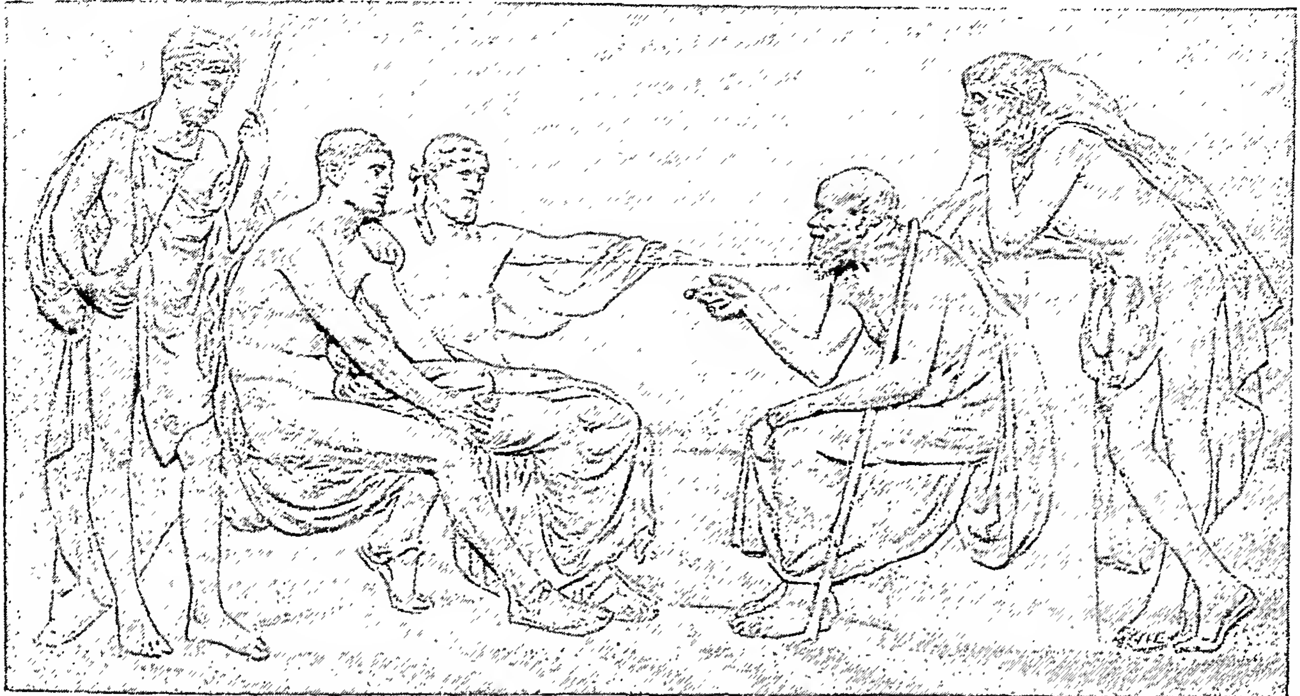
Socrates soon learned to shun the artificial philosophy of his day, which led men merely into confusion and doubt. He turned to the voice of his conscience for moral truth and he enjoyed producing confusion by his simple human questions. Favorite subjects of this attack were Sophists who valued tricks of speech and eloquence above clear and distinct ideas.

"Know thyself" was his motto, and he held that wisdom is virtue and that the wise man is moderate in all things, for only so can he enjoy the keen delights of the mind. He had a sincere desire to expose the absurdities in the life and thought of his time and he did not hesitate to risk his life for justice.

Although he did not set down a word of his teachings, so far as we know, the details of his life and of his doctrine are preserved to us in the writings of the historian Xenophon and the great philosopher Plato. Both of these men were his pupils. It was chiefly through Plato and Plato's disciple, the brilliant Aristotle, that the influence of Socrates was passed on to succeeding generations of philosophers. (See Aristotle; Plato; Xenophon.)

However, Socrates was not appreciated by the Athenian mob and their demagogue leaders. The genius of this "gadfly of Athens" for exposing pompous frauds made him enemies. At last three of his political

THE YOUNG ALCIBIADES LEARNS WISDOM FROM SOCRATES



Bearded Socrates, gesticulating earnestly, is directing his arguments at the youthful Alcibiades seated opposite him. Behind Socrates is another aristocratic young Athenian, not so intent on learning wisdom, if we may judge from his expression. This relief, which is notable for its graceful lines and harmony in composition, is the work of the English sculptor Harry Bates (1850–1899).

foes indicted him on the charge of impiety and corrupting the minds of the youth, and he was sentenced to die by drinking hemlock poison. Refusing to flee, at the appointed hour he swallowed the fatal draught and in the midst of quiet conversation with his friends died as he had lived, a man of unsurpassed courage. "Such was the end," says Plato, "of our friend, whom I may truly call the wisest, justest, and best of all the men I have ever known."

SODIUM. Compounds of sodium flow dissolved in your blood and other body fluids. They season your food and lighten your tea biscuit and cake. They help to tan the leather for your shoes and to bleach the cloth for your garments. They form part of the glass of your windows and your tableware. They probably helped to produce the paper your books are printed on and to finish your photographs. They quite certainly entered into a hundred industrial processes whose products you use daily. In short, animals would cease to breathe and civilization as we know it would stop without the compounds of the silver-white, wax-soft metal sodium, which no one knew existed until the last century.

Sodium, usually in compounds called "sodas," rules industry as potassium rules agriculture. Potassium compounds are nearly like the parallel sodium compounds, and one can generally be substituted for the other in manufacturing. Usually we get only a slight difference in the final product. Thus we can use either caustic potash or caustic soda in making soap. We obtain soft soap from the potash and hard soap from the soda (*see* Soap). Sodium silicates or potassium silicates, or both, can be used in glass-making (*see* Glass). The choice depends upon the qualities wanted in the glass.

Sodium and potassium are equally abundant in the earth's crust, but sodium compounds are preferred for industrial use because they cost less. The secret of low cost was learned in 1791, when Nicolas LeBlanc discovered how to make soda out of common salt. From soda, chemists obtain an ample supply of useful sodium compounds. Chemists never matched this discovery in working up potassium compounds. Hence we have been threatened with potassium shortages from time to time. Today LeBlanc's process is obsolete; but it gave a start to modern industrial chemistry. As long as the sea contains sodium chloride ($NaCl$ or common salt), we shall never have "soda famines" as we have had "potash famines."

The compound we call "soda" is sodium carbonate (Na_2CO_3). We call crude sodium carbonate soda ash. The carbonate also combines with water in crystals. We call these crystals washing soda or sal soda. Soda is used in household cleansing, in manufacturing soap, glass, dye-stuffs, and explosives, in other industries of a scientific or technical nature, and as material from which other sodium compounds are made. Other important sodium compounds, with some of their uses, are: baking soda or saleratus (sodium bicarbonate), ingredient of baking powder; borax (sodium borate), a food preservative and flux in glass-making and metal industries; caustic soda (sodium hydroxide), used in soap-making and mercerizing cotton fabrics; sodium benzoate, a food preservative; sodium thiosulphate (the photographer's "hypo," formerly known as hyposulphite), for fixing nega-

tives in photography; sodium hyposulphite (a different compound), for bleaching and dyeing; sodium disilicate ("water glass"), for preserving eggs, fire-proofing wood, theater scenery, etc.

Sodium belongs to the group of elements known as alkali metals (*see* Alkali Metals). It is never found uncombined in nature, and was first isolated by Sir Humphry Davy in 1807. Pure sodium instantly oxidizes when exposed to the air, and it decomposes water with a violent reaction, seizing the oxygen and a part of the hydrogen and liberating the rest. The pure metal is usually obtained by the electrolysis of sodium hydroxide, after which it is stored under kerosene.

One of the few uses of pure sodium is in the manufacture of sodium vapor lamps. In principle they are similar to other glow lamps (*see* Electrons). The globes contain some neon, which gives a reddish light when the current is first turned on. This heats and *vaporizes the sodium in the globe, and the light turns* yellow. Sodium lamps give two or three times as much illumination as filament lamps with equal current. They are much used along highways.

How Soda Is Manufactured

The historic LeBlanc process produces soda by first heating salt (sodium chloride) with sulphuric acid. The sodium in the salt and the hydrogen in the acid change partners, producing hydrogen chloride or hydrochloric acid, and sodium sulphate or "salt cake." The hydrochloric acid passes off to be absorbed by water; the salt cake is treated with charcoal and chalk or powdered lime, producing a mixture of sodium carbonate and calcium sulphide called "black ash." The calcium sulphide is not very soluble in water; the sodium carbonate is; so the two are separated by washing out the sodium carbonate with water.

The hydrogen chloride and calcium sulphide were at first great nuisances, but about the time what is now known as the Solvay process was put on a commercial basis (1863), these hitherto troublesome wastes became valuable, the hydrochloric acid being largely used in industry and a method being found for the recovery of the sulphur from the sulphide.

The Solvay process (known by the names of the Belgian manufacturers who perfected it), which has largely superseded the LeBlanc, is essentially the treatment of strong ammonia-saturated salt brine with carbon dioxide gas, forced through it from below. The end result of the complicated reactions that follow is the production of ammonium chloride or sal ammoniac and sodium bicarbonate ($NaHCO_3$) or "baking soda." The sodium bicarbonate forms a crystalline precipitate, which is filtered out. This is then heated, driving off hydrogen, carbon, and oxygen, and leaving sodium carbonate (soda).

A still newer process is the electrolytic. The salt molecule in salt brine is split by the electric current (*see* Electrolysis) into sodium and chlorine. The sodium atom displaces one of the hydrogen atoms of the water, forming caustic soda (NaOH).

SOFIA (*sō-fē'ä*), **BULGARIA.** When the Bulgars won their freedom from Turkey in 1878, they made Sofia the capital of their nation. They chose it because *it commands the great trade routes to Belgrade, the* Danube, Macedonia, and Istanbul. The spread of railways and air lines made Sofia one of the important centers of European transportation.

The city stands in the far western corner of Bulgaria. It rises on a plateau, about 1,700 feet above sea level, between the Balkan Mountains and the Rhodope Range. The valleys of four rivers begin near Sofia. Like funnels, they bring the products of the mountains and valleys to the city—timber, lignite, pottery, carpets, wool, sugar beets, hops, grain, and attar of roses. On market days, oxcarts creak alongside Sofia's automobiles and streetcars, and farmers dressed in embroidered felt or homespun clothes mingle with residents clad in Western garb.

Sofia stands on the site of Serdica, a town founded in the second century of the Christian Era by the great Roman emperor Trajan. The town's brisk climate and hot springs made it a favorite resort of Trajan and later of Constantine. In 809 it was seized by the Bulgars, who lost it to Turkey in 1382. After it was freed in 1878, the Bulgars rebuilt it in Western European style, and it became one of the most modern cities of the Balkans. During the second World War, it was heavily damaged by Allied bombings. Population (1946 census), 434,888.

The LIFE-GIVING SOIL, *More Precious Than Diamonds*

SOIL. Our most important natural resource is soil. Without it, plants could not grow; plant-eating animals could not live; therefore meat-eating animals would perish. Soil, like water and air, is indispensable to all life on land.

It differs from water and air, however, in one great respect. The earth has plenty of air and water; but the supply of usable soil is extremely limited.

What is "usable soil"? It is the layer of loose surface material, often called *topsoil,* which contains plant food. The next layer, or *subsoil,* also has loose materials; but it has little or no plant food. Beneath it is a *substratum* of gravel, clay, or bed rock. Land life, therefore, depends upon the topsoil. How thick is it over the earth?

Along the lower courses of great rivers, the good soil may be scores or hundreds of feet thick; but in most places it extends down only a few inches or a few feet. The average depth on American uplands is estimated at seven inches. This soil coating of the earth is thinner, comparatively, than is the fuzz on a peach; yet without it, all land life would perish.

Why We Need to Know About Soil

We may think that, even if the topsoil is thin, we have all we need. This is wrong, for the fertility of the soil is being exhausted at an incredible rate.

We ship huge crops of vegetable foods and plant-fed animals to cities; most of the food values thus taken from the soil never come back. Careless or ignorant farmers also allow erosion by water and wind to strip topsoil from the land.

The replacement of such losses is amazingly slow. Nature takes from 500 to 1,000 years to make one inch of topsoil. From 2,500 to 10,000 years may be needed to replace a loss of from 5 to 10 inches of eroded topsoil. Hence we must learn to conserve our soil. (*See* Agriculture; Conservation; Land Use.)

How Rocks Weather into Soil Materials

Most soil materials were made originally from rock by *weathering*, or breakdown of the rock by sun, water, wind, gravitation, plants, and chemical action.

Sunshine heats a boulder, then a cool rain falls. A film on the boulder surface chills, contracts, and splits off. The rain carries the fragments down the mountainside, and they rasp away more material.

CONTRASTING SOIL FORMATIONS

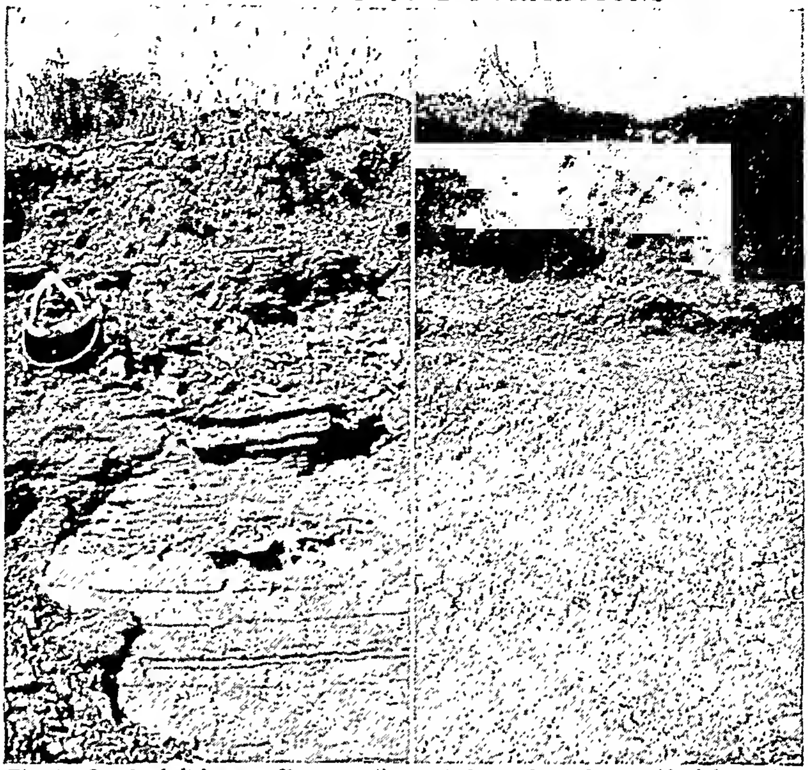


Fig. 1. On the left is a profile or section cut down through a *residual formation.* This is the result of the weathering of rock in place and the materials are graduated evenly from soil on top to unaltered rock at the bottom. At the right is an *alluvial formation,* showing a distinct dark layer of water-borne material.

Wind hurls sand like a sand blast against rocks, and rubs away material. In winter water freezes in the cracks, expands, and splits off pieces, often with a noise like a pistol shot. Boulders and even avalanches break loose, and grind and smash rock as they fall. Trees rooted in crevices fall and break loose more rock.

Rocks are further weakened by the action of oxygen, which combines with many substances such as the iron found in most rocks. We see the iron oxides as reddish or brownish stains.

Carbon dioxide and water together form carbonic acid, which attacks most rocks, but particularly limestone and other rocks containing calcium. The resulting calcium carbonate is dissolved away in water, and in time the limestone is destroyed.

Nitric and nitrous acids, formed by lightning and moist air, attack rocks. Perhaps 25,000 tons of nitric acid are formed daily over the earth.

Granite contains particles of quartz and mica, cemented together by silicates. Various chemical agents transform the silicates, perhaps into clay. The separate quartz particles form sand (*see* Clay; Sand).

Such processes in time turn all rock into gravel, sand, silty material, and dissolved material. (Gravel includes pieces thicker than 2 millimeters, or about 8/100ths of an inch. Pieces down to 1/16th of a millimeter are sand; finer particles form silt or clay.)

How Soil Materials Become Organized

On sharp slopes, weathered material falls away and exposes more rock to attack. On gentle slopes or level surfaces, such material may lie in place, protecting the rock and settling into a *residual* formation. Residual formations (Fig. 1) show an even gradation from fully weathered material at the top to unchanged parent material at the bottom. The chemical character of the parent material may persist strongly. Granite, for example, tends to form acidic soil; limestone lends an anti-acid, or basic, character.

Most soil materials, however, are *transported* to some extent. A swift stream can roll gravel along, and carries sand and silt indefinitely. When it slows, the gravel drops out first, then the sand, and finally the silt. Water-made, or *alluvial*, deposits usually form a distinct layer over other material (Fig. 1).

Strong winds may deposit sandy or silty materials hundreds of miles from their sources. Such wind-made, or *aeolian*, formations are fine and powdery. When such material becomes packed, it is called *loess*. Usually it is yellowish in color. When loess is cut or eroded, it falls away in squarish blocks, leaving sharp, upstanding edges. North China and Nebraska have extensive deposits of loess (Fig. 2).

Many soils have been developed in glacier-made, or *morainic*, material. An advancing glacier grinds the rock beneath with terrific power. When it retreats, it leaves a jumble of material, including boulders, which becomes *drift* soil. In many regions, such as the Columbia River basin, volcanoes have provided soil materials such as decayed lava and volcanic ash. These form *volcanic* or *volcanic ash* soils.

Texture and Tilth

The materials in a soil and its formation affect its texture—its coarseness or fineness and the way it

SOME OF NEBRASKA'S FAMOUS LOESS

Fig. 2. Note how this loess, or soil made from wind-blown material, breaks off in blocks with squarish, upstanding edges, when occasional rains erode it on each side of the gulley.

breaks up. Texture in turn affects plant life, because root hairs work through the *pore space* between particles, and this space depends upon texture.

Moreover, plants get food, not from solid particles, but by soaking up water in which the foods are dissolved. The finer and more closely packed the particles are, the more water and food a soil can hold. Sand dries out rapidly, while clay holds water well. But if the pore space fills with water, plants "drown" because their roots cannot get air. Fine particles also hold water bound, or *adsorbed*, on their surfaces (*see* Colloids); plants cannot use this water.

A coarse-textured surface speeds evaporation by exposing water to air, and then draws more water up by capillary attraction (*see* Capillary Action). A fine-textured surface holds water better; hence dry farmers powder the surface to conserve water.

Air supply too depends largely upon texture. Warm air works quickly into coarse, sandy soils in spring; hence such soils are called *warm* or *early*. Fine-textured clay soils are *cold* or *late*.

Tilth, or behavior of soil under cultivation, depends partly upon texture Soil with loose, small particles may crumble to powder when worked. Other textures are called crumb, plate, massive, pyramidal, or nut, according to the way the soil breaks up. Soils are also classed as *light* or *heavy*, meaning easy or hard to work. A farmer calls sand light, and clay heavy, though a cubic foot of sand weighs about 100 pounds, and dry clay about 75 pounds.

How Plants and Animals Help Make Soil

When plants die, water leaches plant food from them, and carries it down into the pore space. This organic matter, or humus, gradually turns the soil into *loam*, which is soil rich in organic matter.

Plant roots help water to drain or percolate into the soil. In dry times capillary attraction draws water up the channels made by the roots, bringing with it material which has leached down. Plants also draw up water which escapes, or transpires, from the leaves. Plant rootlets may split the strongest rock, by working into cracks and exerting pressures of from 200 to 300 pounds a square inch (*see* Plant Life).

Soil is enriched also by the wastes and decayed bodies of animals. Some animals—ants and earthworms, for example—help by mixing the soil (*see* Earthworm). Many insects indirectly enrich soil by fertilizing flowers and thus aiding the spread of plant life (*see* Bee, Flowers).

What Plants Need From Soil

The value of soil depends upon the supply of plant foods it contains. Plants must have ten chemical elements, called *essential* elements. These are oxygen, carbon, hydrogen, nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, and iron Some, perhaps all, plants also need traces of the *minor* elements—boron, chlorine, copper, iodine, manganese, silicon, sodium, molybdenum, and zinc.

Three-fourths of the weight of living plants is water (oxygen combined with hydrogen). Of the *dry* weight, 11 per cent is carbon, 10 per cent oxygen, and 2 per cent hydrogen, all obtained largely from water and carbon dioxide from the air. Only 2 per cent of the plant's weight comes from the soil. But the amount of these elements needed for crops is tremendous.

About 60 pounds of nitrogen, 11½ pounds of phosphorus, and 32½ pounds of potassium are needed to produce 35 bushels of wheat. A 75-bushel yield of corn takes 108 pounds of nitrogen, 18⅓ pounds of phosphorus, 64 pounds of potassium, and 9 pounds of calcium. Two 500-pound bales of cotton take about 164 pounds of nitrogen, 22 pounds of phosphorus, 81⅓ pounds of potassium, and 83 pounds of calcium.

Nitrogen, Phosphorus, and Potassium in Soil

Soils vary greatly in their content of nitrogen, the most important element by weight. Some piedmont and sandy soils have less than 800 pounds to an acre, peats may have 34,000 pounds. Good soil of 7-inch depth should have about 5,000 pounds to the acre.

Plants need nitrogen to make proteins (*see* Proteins); but they cannot use pure nitrogen from the air. A few plants can get nitrogen from ammonia, but most plants must get it from nitrates (*see* Nitrogen). Lightning and moist air make some nitrates, but not enough. The main supply, from 15 to 40 pounds a year to the acre, is made from the air by certain bacteria (*Azotobacter chroöcoccum* and *Clostridium pasteurianum*). Another nitrogen-fixing bacterium (*Bacillus radicola*) lives on the roots of leguminous plants such as clover, alfalfa, peas, and beans. By some unknown process it supplies nitrates to the plant in

return for carbohydrates. When the plants die and decay or are plowed under, the nitrates are added to the soil. Decay of dead plants and animals, caused largely by bacteria, changes the nitrogen compounds they contain to ammonia. Certain bacteria (*Nitrosomonas* and *Nitrosococcus*) build the ammonia into nitrites; others (*Nitrobacter*) build the nitrites into nitrates, which plants can use.

Nitrogen is lost from the soil in many ways. Nitrates dissolve in rain water and are carried off. Crops and food animals constantly take it away. On the other hand, nitrogen-fixing bacteria are active only when the temperature is between 54° and 130°F., and nitrite-forming bacteria do not act in acid soil. Hence, after a few years of farming, most land lacks the nitrogen needed to produce well, unless nitrogenous fertilizers are applied (*see* Fertilizers).

Phosphorus and potassium also may become exhausted. Natural replacement of the compounds containing these elements is extremely slow or even lacking in many regions, and phosphate fertilizers must be used to supply phosphorus, and potash fertilizers for potassium. The minor elements too may be lost, reducing both the resistance of plants to disease and pests, and also the food value of crops (*see* Minerals).

SOILS FROM TREES AND GRASS

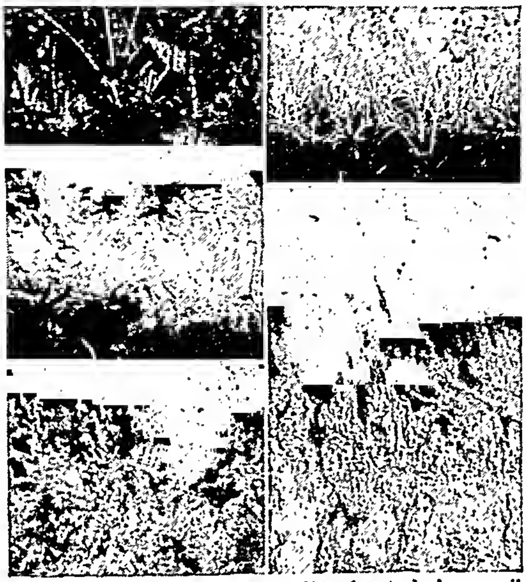


Fig. 3. At the left is the profile of a *podsol*, or soil formed beneath a cool pine forest. At the right is a rich black *chernozem*, in the western wheat country.

Modern Theories of Soil Formation

Until recent years, soil scientists thought of the soil as a mere storage bin, into which parent materials and organic matter were poured, and from which plants drew what they needed. Before the first World War, however, various Russian workers discovered a surprising new principle of soil formation. They found that every soil, far from being a mere storage bin, changes slowly through the centuries, in response to the climate of the region, until its character matches the climate just as does the plant growth.

These changes are produced, largely by water action, in layers or *horizons* of the soil. In moist climates other than polar ones, the top layer, or topsoil, loses material by leaching to the subsoil. Hence these layers or horizons are called the zones of *eluviation* and *illuviation* (meaning, respectively, zones of loss and of gain by water action). In dry climates, however, rapid evaporation after a rain promptly brings up as much dissolved material as the rain carried down, and perhaps a little more.

These two horizons (topsoil and subsoil) taken together are called the *solum*, to distinguish them from the substratum, or third horizon, which does not change. For convenience the three horizons usually are called horizons A, B, and C, from top to bottom. Together they form the *profile*, or complete section, of the soil (Figs. 1 and 3).

Polar-Climate or Tundra Soil

The simplest effect of climate upon soil is seen in polar tundras. Here the soil is always frozen, except for a thin layer (horizon A) which thaws in summer. Since nothing can leach down to the subsoil (horizon B), this horizon shows the same dirty gray color as the substratum (horizon C). Horizon A is streaked with brown humus, obtained from mosses and lichens.

Soils in Wet and Dry Climates

Elsewhere the soil thaws deeply, and can undergo extensive change, according to climate. The changes are classified, first, according to whether the climate is wet or dry.

The chief change in wet-climate soils is leaching of soluble nitrogen compounds, and lime salts or compounds of calcium, from horizon A to horizon B. Calcium salts are basic, or anti-acid (*see* Acids and Bases). Loss of them leaves the topsoil with an acid character, due chiefly to acid compounds of iron and aluminum. Curtis F. Marbut, who did most to apply the Russian ideas to American soils, called such a soil a *pedalfer*, from the Greek word *pedon* for ground, *al* for aluminum, and *fer* for *ferrum*, or iron.

In dry climates this action is reversed. Instead of being leached down, the calcium salts tend to be brought up by evaporation after every rain. This action may develop a layer of calcium carbonate in the topsoil. Such soils are called *pedocals*, from *pedon* and *cal* for calcium. So-called alkali soils are pedocals, although calcium carbonate is not an alkali.

In the United States, this great division between wet-climate and dry-climate soils occurs midway across the country, as shown in Fig. 4. Within each division, the soils may be classified further according to changes produced by other factors. In wet-climate soils, the principal further factor is temperature.

Forest Soils in Cool and Temperate Climates

Moist climates favor the growth of trees. In cool, moist climates, where the trees are conifers (evergreens), the combination of abundant moisture, coolness, and conifers produces a soil called a *podsol* or *podzol* (Fig. 3). The term means "salty soil."

This soil is acid, for two reasons: first, because calcium is leached away; and second, because coniferous trees do not use much basic (alkaline) material and hence do not restore such material to the soil when the leaves and wood decay. It is also poor in nitrogen, because the long winters hamper the nitrogen-fixing

THE MAJOR SOIL REGIONS IN THE UNITED STATES

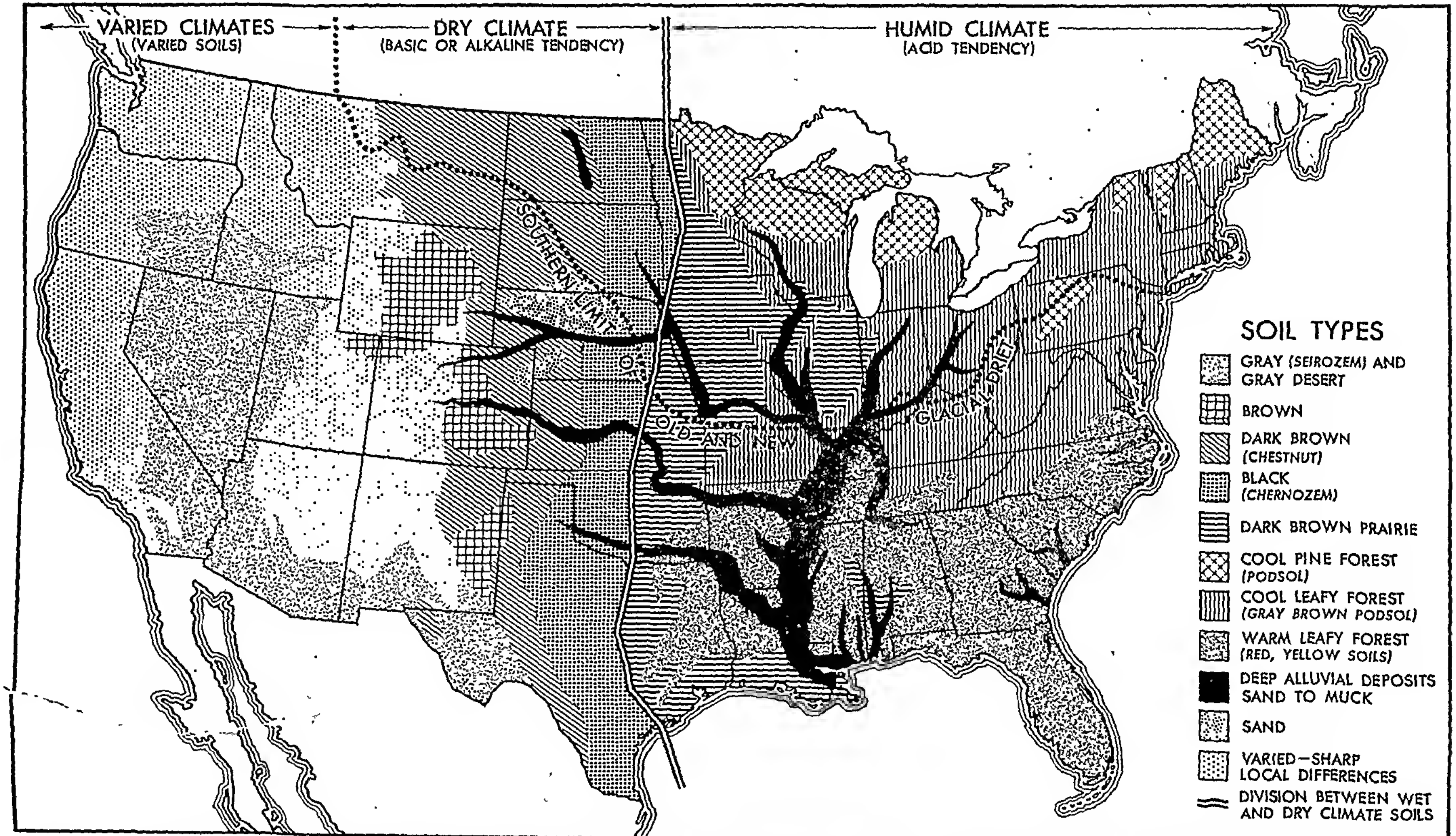


Fig. 4. This map shows the principal types of soil which have been developed by climatic forces in the United States. To trace the regions, note first the division, somewhat east of the 100th meridian of longitude, between the acid and the basic soils (*pedalfers* and *pedocals*). This matches the division between humid and dry climates; it should be compared with the map in the article on Drought, and various maps in the article on the United States. Note also how soils in moist climates vary from north to south, according to temperature and the kinds of trees the climate supports. Within each soil region, the soils developed by climate may vary, according to the way the soil materials were deposited. Thus, the great rivers in the Mississippi Valley are bordered by alluvial deposits, which in time take on the character appropriate to the climate. The glacial drift soils also vary from east to west, according to climate. In the mountainous region of the West, a desert area stands out clearly. Otherwise, the soils vary greatly from valley to valley, according to the rainfall and other conditions; but the differences cannot be shown on a map of this size. In the East, an interesting local variation which is large enough to show on the map is the patch of dark-brown prairie soil in Alabama and Mississippi. This is kept from sharing the regional acid tendency by an underlying formation of limestone.

HOW LIMING HELPS ACID SOIL

Fig. 5. The right half of this field was treated with crushed limestone; the left half was untouched. The difference in growth proves the value of the treatment.

bacteria. The profile of such a soil shows an A horizon with two layers—an upper A_1 layer of raw humus, and a lower A_2 layer having an ashy or salty appearance. The B horizon is stained reddish-brown by iron compounds and humus. Such soil is extremely poor for farming.

In milder climates, deciduous trees (those that shed their leaves in winter) tend to supplant the conifers. These trees use more basic materials than do conifers, and so help correct acidity in the topsoil. Longer summers promote nitrogen enrichment; plant life and humus are more abundant. The resulting soil, known as a *gray-brown podsol*, is good for crops. It shows an A_1 horizon of humus, an A_2 horizon from gray to brown in color, and a B horizon stained brown by humus and iron compounds. This was the soil usually found by the settlers who cut down the forests to obtain farms, between the Appalachians and the Mississippi River.

Warm-Forest and Tropical-Forest Soils

In warm temperate climates, loss of calcium and strong oxidation of iron give the soil profile a red or yellow color. Completely oxidized (ferric) iron gives red; incompletely oxidized (ferrous) iron gives yellow. Thus *red soil* and *yellow soil* are formed.

In regions such as the Congo and Amazon river basins, the heavy tropical rainfall leaches away nearly all plant food, and the soil is red with ferric oxide. Plants get food, not from the soil, but from the decayed material on top of the soil. Particles of such soils have a jelly-like film of minerals, which hardens and lumps the soil when exposed to air. Hence these soils are called *laterites* (from the Latin word *latus*, for brick).

Soils in Deserts and Subhumid Climates

In dry climates, the soils differ principally according to the amount of moisture they receive, ranging from none to about 20 inches of rainfall a year.

In complete deserts, the soil has a light-gray or whitish-yellow profile, and is called *gray desert* soil. Where scant rainfall produces a few grasses and other plants, the soil has brownish streaks of humus, and is called a *gray soil*, or *seirozem*.

As moisture increases, so does humus. Thus we have *brown* soils, and *dark-brown* or *chestnut* soils. In the subhumid belt of somewhat less than 20 inches of rain a year, we find deep *black* soil, with a lime-colored subsoil, because calcium salts are not leached away. The Russian name for this soil is *chernozem*, meaning "black soil." Because of its humus and calcium, this soil is fine for wheat (Fig. 3).

Between the humid belt and the subhumid belt in the United States lies *dark-brown prairie* soil. It has deep humus, but it is brown rather than black. It is not so rich as a chernozem, but better rainfall makes it more valuable for general farming.

Soil Management to Maintain Fertility

Because of the various qualities of these different soils, soil management—planning of crops, cultivation, and use of fertilizers to maintain fertility—must vary in different parts of the United States. In the East, the most common soil trouble is a tendency to become *acid* or *sour*. Acidity not only hurts crops, but it prevents growth of clover and replenishment of nitrates. The remedy is crushed limestone, added as indicated by the *Comber test*.

To make this test, potassium thiocyanate is dissolved in grain alcohol, 25 grams of chemical to each 25 cubic centimeters of liquid. Each soil sample is shaken well, and allowed to stand for ten minutes. Lack of color indicates no acidity. A faint pink indicates need for two tons of limestone to the acre; a light cherry, 3 tons; and a deep cherry, 4 tons. After liming, a crop rotation starting with clover may give double yields and much better quality (Fig. 5).

The remedies for alkalinity depend upon the kind of soil, the local climate, and whether irrigation is used. No general rules can be given.

Official Classifications of Soil

Government soil maps and surveys classify soils, first by *series*, and second, by topsoil *texture*. A series has a certain order of materials below the topsoil; the series name, taken from the locality where the series was first studied, is used wherever this order of materials is found. For example, "Miami loams" may occur far from Miami.

The official texture types are *sandy*, with less than 20 per cent silt and clay; *sandy loam*, with from 20 to 50 per cent loam, silt and clay; *loam*, with 30 per cent or more loam; *silt loam*, with 50 per cent or more of silt, and 20 per cent or less of clay; *clay loam*, with 20 to 30 per cent clay; and *clay*, with 30 per cent or more of clay. These terms are added to the name of the soil type. Thus, we can have a silt or a clay Miami loam. Deep alluvial soils vary from gravel and sand to *muck*, which contains from 15 to 50 per cent organic matter.

A FLASH OF KING SOLOMON'S WISDOM

The fame of Solomon's wisdom spread throughout the ancient world. He could discern truth and justice in doubtful cases because of his deep understanding of human nature Here, Christian Schussele, in a painting done in 1860, portrayed Solomon making one of his dramatic pronouncements before his court. The incident, involving an iron worker, is not mentioned in the Bible

SOLOMON, KING OF ISRAEL (about 960 B.C.). Nearly three thousand years have passed since the reign of Solomon, the wisest and most magnificent king in Israel's history. Solomon was little more than a youth when he succeeded his father David. His kingdom was wealthy and powerful for its day. It extended from the Euphrates River in the north to Egypt on the south (*see* David).

The Bible tells that God appeared to Solomon in a dream at the beginning of his reign and asked him to express a wish. Solomon prayed only for an understanding heart that he might rule with justice.

Solomon showed his wisdom in small and in great affairs. He was called upon to decide a dispute between two women, who both claimed the same child. "Divide the living child in two, and give half to the one, and half to the other," said the king. Whereupon one of the women cried out and begged him to give the babe to the other, thus showing that she was the real mother, since she would rather give up her child than have it harmed (I Kings iii, 16–28).

Not only his own subjects but rulers from distant lands came to consult Solomon. The Queen of Sheba, in Arabia, came with a great train, bearing gifts of spices and gold and precious stones. Greatly did she marvel when Solomon answered all the questions and riddles which she put to him and showed her all the splendors of his court. "Behold, the half was not told me," she said to Solomon; "thy wisdom and prosperity exceedeth the fame which I heard."

Princes of many lands brought gifts of friendship and formed alliances with him. With the help of the Phoenicians, trading vessels were sent to Ophir (a land probably in southern Arabia, famed for its gold), and as far as Tarshish (probably Spain). Gold and silver, ivory, horses, and linen were among the treasures brought to Solomon's realm.

Now that there was rest from war, Solomon was able to carry out the plan which his father David had cherished—the building of a great temple. After seven years this temple, built of stone and cedar of Lebanon, carved within and overlaid with pure gold, was completed and dedicated to Jehovah. Adjoining the temple Solomon built a splendid palace.

But Solomon, for all his wisdom, had some very grave faults. He had many foreign wives, and he allowed them to build altars to their divinities, thus bringing idolatry into the land. In order to maintain his luxurious court, he taxed his subjects heavily. As the king's character weakened, so did his hold over the people, and his death was the signal for the division of the kingdom.

SOLON (about 638–558 B.C.) In the market place of ancient Athens a crowd gathered about a wild-looking man. From his disordered clothing and wild gestures he appeared to be insane. Suddenly, with eyes flashing, he broke forth in verse:

> On then to Salamis, brothers!
> let us fight for the beautiful island,
> Flinging afar from us ever the
> weight of unbearable shame!

The crowd listened with amazement. Many costly attempts had been made by the Athenians to retake the island of Salamis from the neighboring state of Megara. Finally in despair they had passed a law forbidding anyone, under penalty of death, to suggest another attempt. Solon escaped the penalty for breaking this law by pretending to be mad. As he had hoped, the people immediately recognized the fervent appeal which lay behind his poem. Inflamed by Solon's words the Athenians tried once again to capture the island. This time they succeeded, and Solon became the hero of the day.

So runs an old story about this great Greek leader. Whether the story is true or not, the Athenians did turn to Solon in another crisis. This was brought about by the new development of Athens as a commercial state. Great fortunes were being made in trade, but the laborers and peasants found life harder and harder. Small farmers were obliged to borrow money at ruinous interest and were losing their mortgaged lands. Many were sold into slavery to satisfy their creditors. A revolution threatened.

The people elected Solon archon—the highest office in the state—and gave him power to draft a new code of laws to displace the harsh old laws of Draco. Solon quickly made widespread economic reforms. He ordered all those enslaved for debt to be freed. He forbade future loans based on the security of a debtor's person and canceled all debts thus secured. He also set a limit to the amount of land which a man might hold.

In addition, Solon enacted laws that stimulated Athenian trade and manufacturing. He gave citizenship to aliens engaged in manufacturing, and he ordered fathers to teach their sons a trade. He also made the Athenian coins, weights, and measures uniform with those of neighboring states. These reforms paved the way for the future commercial greatness of the ancient city.

Equally important were Solon's constitutional reforms. He improved everyone's chance of securing justice by ruling that one who had lost a lawsuit could appeal the case to a jury of citizens. He allowed even the humblest men to serve on this jury and take part in meetings of the Assembly. He also gave everyone a voice in the election of the magistrates, thus laying the broad foundation of Athenian democracy.

Then, according to an old story, Solon caused these laws to be inscribed on wooden tablets so that all would be familiar with them. Many of the new reforms, however, drew criticism. Annoyed by constant suggestion to amend his laws, perhaps, Solon obtained permission to travel abroad for ten years. He first journeyed to Egypt and Cyprus and then to Asia Minor. It was during this time that his legendary visit to the fabulously wealthy King Croesus of Lydia is supposed to have taken place (*see* Croesus). This visit is pictured below.

The revolution which Solon had sought to avoid did finally take place. Pisistratus, a member of a powerful noble family, seized supreme power and ruled as "tyrant" for more than 30 years. But Solon's ideals of law and justice and democracy remained a powerful influence throughout Athenian history.

Solon was one of the Greek sages whom the ancients honored by calling the Seven Wise Men of Greece. Many famous sayings were attributed to them, such as "Nothing in excess"; "Know thyself"; "Moderation is the chief good." The names of the others usually included in this list are Thales, Periander, Pittacus, Cleobulus, Bias, and Chilon.

SOLUTIONS. If we drop some sugar into a glass of water and watch it gradually disappear, we are witnessing one of the most important actions in nature. This is the action in which one substance dissolves another to form what is called a solution.

The sea is salty because water dissolves minerals from soil and rocks. Plants grow because they can take up gases from the air and minerals from the soil in the form of watery solutions. Much of the food we eat is changed by digestion into substances that will dissolve in the blood and so can be distributed to all parts of the body.

What happens when a substance "goes into solution"? We saw the sugar disappear in the water. Now

SOLON VISITS THE COURT OF CROESUS

Rich King Croesus, after showing Solon his vast treasures, asked him who was the happiest man he had ever met. The wise Greek replied, "I count no man happy until his death, for no man can know what the gods have in store for him."

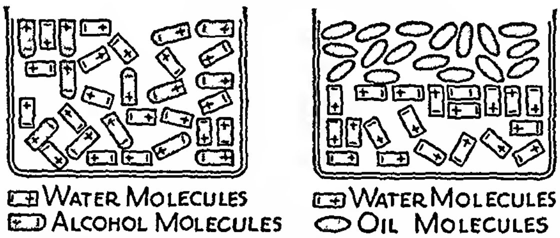
it will no longer settle to the bottom of the glass, nor can it be removed from the water by filtering. Yet we know the sugar is still there, for the solution tastes sweet; and, if we let the water evaporate or boil away, we get the solid sugar back again in the form of crystals in the bottom of the glass.

Characteristics of True Solutions

Here is what took place. The sugar broke up into the tiny particles called molecules (*see* Chemistry), and these sugar molecules mixed themselves evenly among the water molecules. But otherwise they remained unchanged. We may define a true solution, then, as a mixture of the free and separate molecules of two or more different substances, one of which is a liquid. The liquid is called the *solvent* and the substance dissolved in it is the *solute*.

The dissolved substance may be a solid (as in our sugar solution), or another liquid (as when alcohol and water are mixed), or it may be a gas. Water that is exposed to the atmosphere always has some air dissolved in it. It is this dissolved air that fishes breathe by extracting it from the water with their gills. The bubbles that rise from so-called "charged" or "sparkling" beverages are formed by carbon-dioxide gas previously forced into solution under pressure.

TO MIX OR NOT TO MIX



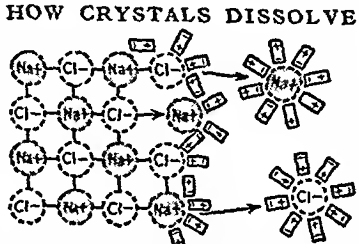
When two polar compounds like water and alcohol are mixed (as shown at the left), their molecules attract one another, and arrange themselves with unlike poles touching. A non-polar compound (at the right) has no attraction for the water molecules, hence is pushed into a separate layer.

Mixtures of two gases are not commonly called solutions, nor are mixtures of two solids. Alloys, however, formed by melting two metals together are sometimes called "solid solutions."

Frequently the molecules of a substance will not separate completely in a solvent but remain in tiny clusters. This produces a *colloidal solution*. Milk and liquid glue are examples. The properties of such a solution differ in several respects from those of a true solution (*see* Colloids).

Other substances break down more completely than sugar when they go into solution. In a solution of common table salt, many of the molecules are divided into fragments called *ions*. Chief among substances that form ionized solutions are acids, bases, and salts. Ionized solutions are true solutions. They conduct electricity readily and are chemically very active (*see* Acids and Alkalies; Ions).

HOW CRYSTALS DISSOLVE



Water dipoles drag ions from the crystal surface of the salt and surround them. The unlike signs of the dipoles and the ions attract each other.

The amount of a substance that can be dissolved in a given quantity of solvent is a measure of its *solubility*. The solubility of solids almost always increases when the solvent is heated. For example, about four pounds of sugar will dissolve in a quart of ice-cold water (32° F.), but more than ten pounds will dissolve in a quart of boiling water (212° F.). Salt is less soluble than sugar and less affected by increased temperature. About 13 ounces of salt will dissolve in a *quart* of ice water, and about 14 ounces if the water is boiling. Calcium sulphate is one of the rare solids that is less soluble in hot than in cold water. On the other hand, the solubility of all gases decreases as the temperature of the solvent rises. But solubility increases if the gas is under pressure when it is exposed to the solvent.

When a liquid at a given temperature has dissolved all of a substance that it can hold, the solution is said to be *saturated*. As a hot, saturated solution of a solid cools off, some of the dissolved substance may come out of solution and solidify again, forming crystals on the side of the container or dropping to the bottom as a *precipitate*. In certain cases, however, the surplus may remain in solution after the liquid has cooled. The solution is then said to be *supersaturated*. Jarring or agitating the liquid or dropping into it a tiny fragment of the dissolved material will usually cause the surplus material to solidify suddenly.

When solids or liquids go into solution, they raise the boiling point of the solvent and lower its freezing point. For example, an ounce of salt in ten ounces of water raises the boiling point from 212°F. to 214° and lowers the freezing point from 32°F. to 20°. The higher boiling point is a result of a decrease in vapor pressure (*see* Evaporation; Water).

The Strength of Solutions

The strength or concentration of a solution is commonly indicated by a percentage number. A 5 per cent salt solution indicates 5 parts by weight of salt to 95 parts by weight of water. In chemical work, however, *molar solutions* and *normal solutions* are used as standards. A molar solution is one which contains one molecular weight of a substance measured in grams (1 *mol* as it is often called) for each liter of solution. For example, the molecular weight of hydrochloric acid being 36.5, a molar solution of it would contain 36.5 grams of acid to the liter.

A normal solution contains its "equivalent weight" for each liter. This is the molecular weight of the substance divided by the valence it represents in terms of hydrogen (*see* Chemistry). The equivalent weight of hydrochloric acid is the same as its molecular weight, for the hydrogen valence represented in the formula HCl is one. But the equivalent weight of sulphuric acid (H_2SO_4) is its molecular weight divided by 2, for it shows two hydrogen valences. To get equivalent weight of aluminum chloride ($AlCl_3$),

the molecular weight is divided by 3, for the three chlorine atoms are hydrogen equivalents.

Two or more solutions prepared in this way can, therefore, be intermixed with the assurance that their various chemical affinities or "strengths" match one another, a condition which does not prevail when ordinary percentage solutions are used. The notations N/1, N/10, or 2N before the name of a chemical indicate respectively, normal, one tenth normal, and twice normal strengths of solution. Molar solutions are similarly indicated by the initial M.

Solubility—Polar and Nonpolar Effects

A mystery of long standing has been the wide difference in the solubility of various substances. Water will mix readily with certain liquids (as alcohol, glycerin) and very poorly with other liquids (as benzene, oils). Some solids dissolve in water (as salt, sugar), while others are but slightly soluble (as camphor, fats). Many substances insoluble in water dissolve well in such *organic solvents* as acetone, benzene, and ether.

The present theory of solution is that molecules of water are in the form of tiny magnets, each with one end as a + pole and the other end as a − pole (*see* Magnet). These are called *water dipoles*. Alcohol is also a *polar* compound. Hence water and alcohol mix readily because each "water magnet" can put a + pole against the − pole of an alcohol magnet or vice versa. In other words, the mutual attraction of unlike poles enables the particles to intermingle freely, as the diagram on the previous page shows.

Liquids that are *nonpolar*, such as gasoline, oils and fats, or benzene, do not mix completely with water. They are pushed into a separate layer, which rises to the top if the liquid is lighter than water or settles to the bottom if it is heavier. Molecules of nonpolar liquids have no + or − charges, and hence have no attraction for the water dipoles.

When water dissolves crystals of polar compounds, the water dipoles drag the ions from the surface of the crystal and surround them. The ends of the dipoles with unlike signs point inward, and the charged atom is isolated as if by a cover. Crystals that dissolve well in water usually will not dissolve in nonpolar solvents, such as benzene and chloroform. Conversely, compounds that cannot separate into charged atoms (ions) often will not dissolve in water but dissolve in the organic solvents. Chemists have a saying that—with some exceptions—"like dissolves like."

SOMERVILLE, MASS. Transportation links with all New England and a thriving industry helped build the city of Somerville. Growth began in the early 1800's while Somerville still was a part of Charlestown. Bridges were built connecting Cambridge and Charlestown with Boston; and the Middlesex Canal between Somerville and Lowell was completed in 1803. The Boston-Lowell railroad through Somerville opened in 1835. Somerville became a separate town in 1842.

Today, Somerville is the hub of a network of highways and branch rail lines. Its modern industries include meat packing, other food processing, printing, automobile assembly, and the manufacture of structural iron and steel and furniture.

Somerville occupies seven hills stretching south from the Mystic River. It is surrounded by Charlestown (now a part of Boston), Cambridge, Arlington, and Medford. Most of Governor John Winthrop's "Ten Hills Farm" lay in present-day Somerville. The site was settled in 1630, and from here the governor the next year launched *Blessing of the Bay*, probably the first ship built in Massachusetts. The Old Powder House, built as a gristmill about 1703, served patriots during the Revolution as a gunpowder storage house. Tablets on Prospect Hill Tower commemorate a fort manned by patriots during the siege of Boston and the raising on Jan. 2, 1776, of the 13-striped Cambridge flag (*see* Flags).

Somerville was chartered a city in 1871. The city's water supply and sewage-disposal facilities are controlled by the Boston Metropolitan Commission, a state-appointed body. (*See also* Massachusetts.) Population (1950 census), 102,351.

SOMME RIVER. For much of its length the Somme River in northern France appears to be little more than a quiet stream. But through the ages, the Somme Valley has seen many a crisis of war; and it is perhaps equally conspicuous in the annals of man's prehistoric record. The first real understanding of man's Stone Age days in Europe came from its banks.

The Somme rises near the border between Belgium and France and flows westward for 140 miles to the English Channel. Its valley is a rich agricultural region, corresponding roughly to the old French province of Picardy. After passing St. Quentin and Amiens, the river broadens to an estuary at Abbeville. The mouth is marked by the town of St. Valéry.

The Somme in Prehistoric Times

During the four glaciations of the Ice Age, the lower course of the Somme received great floods of water from melting ice farther inland. The floods cut terraces in the sides of the valley and littered them with stone, including easily chipped flint.

From the start of man's career in this part of Europe, men used this stone to make crude tools. They left many relics, and today these give hints of the rude lives of these early men and their slow progress in toolmaking. Today one of the richest records of the early Stone Age is the series of deposits at St. Acheul near Amiens.

The Somme in Two World Wars

During the second World War, the Germans made their first attack upon France with a lightning thrust of armored columns from the Ardennes westward to the mouth of the Somme. Then, while they turned north to crush the Allies in Belgium and northern France, the French tried to organize a defense south of the Somme. But the Germans broke through and swept on to capture Paris June 14, 1940. The French then surrendered (*see* World War, Second).

The first World War saw much more stubborn and bloody fighting. On Nov. 18, 1916, when the first

battle of the Somme ended, 500,000 men had been killed on both sides.

The second battle of the Somme, sometimes called the battle of Picardy, marked the opening of the great German offensive in the spring of 1918. Beginning March 21, the Germans thrust out from St. Quentin and advanced rapidly more than 20 miles. On March 26, Gen. Ferdinand Foch was given command of all Allied troops. He organized a defense which by April 6 stopped the Germans just east of Amiens; and four months later they were driven out of the Somme valley (*see* World War, First).

SORGHUM. When we hear the word "sorghum," most of us think first of syrup, for the United States makes 12,000,000 gallons of sorghum syrup in an average year. Sweet sorghum (or sorgo) is grown in every state in the Union, though manufacture of the syrup for the market is largely confined to southeastern and south central states. The sweet juice in the plant stems is extracted by grinding and reduced to a thick syrup by boiling and evaporation. Most sorgo syrup manufacturing in the United States is done on farms not in factories.

THE MOST VALUABLE SORGHUM

This is kafir, commercially the most important of the sorghums. It was introduced into the United States from South Africa in 1876 and is a valuable grain and forage crop in many southwestern states.

Many varieties of the sorghum, however, are not sweet. The most important use in the United States for sorghum, even the sweet sorghum, is for forage and grain. It makes excellent pasturage for hogs, sheep, cows, and horses and is also fed as hay or put in silos. Ground sorghum seed, especially that from grain sorghums, makes a good feed for livestock, as does also the ground stock fiber or refuse left after syrup making. Kafir is one of the best-known grain-feed varieties (*see* Kafir). Another interesting member of the sorghum group is broom corn, which grows the thick and strong head or brush used in the manufacture of brooms. Milo, feterita, durra, and shallu are other well-known and useful grain varieties. Sudan grass, a grass sorghum first obtained from Khartum in 1909, is grown widely in the United States for pasture and hay.

Sorghum was cultivated 4,000 years ago in Africa and in some parts of India and China. In these countries it is valued today chiefly for its seed, which is a staple food of the natives. Some of the non-saccharine (sugarless) sorghums are particularly valuable crops in regions where the rainfall is light, such as the dry-farming areas of the western United States.

The sorghums (*Andropogon sorghum* or *sorghum vulgare*) belong to the grass family. They have jointed, pithy stems, 4 to 20 feet tall. The plant resembles Indian corn (maize) except that it is earless, the seeds growing on the top of the stalk.

The VIBRATIONS *of* MATTER *Called* SOUND

SOUND. What is sound? How does it travel? Why do we see the distant lightning flash before we hear its thunder? Why does a bell seem to sound many tones when it is struck? Such questions as these baffled the wisest men for centuries. Today, however, the science of sound is one of the best understood of all the many branches of physics. The mystery has disappeared.

Every kind of sound has its beginning in a vibrating object. That object may be a violin or an automobile horn or a barking dog. Whatever it is, some part of it is vibrating while it is producing sound. The vibrations of the object disturb the air in such a way that *sound waves* are produced. These waves travel out in all directions, expanding in balloon-like fashion from the source of the sound. If the waves happen to reach our ear, they set up vibrations which we hear as sound (*see* Ear).

Sound, then, depends on three things. There must be a vibrating object to set up sound waves, a *medium* (such as air) to carry the waves, and someone's ear to receive them. Sound waves cannot travel through a vacuum, as an experiment pictured on a later page demonstrates.

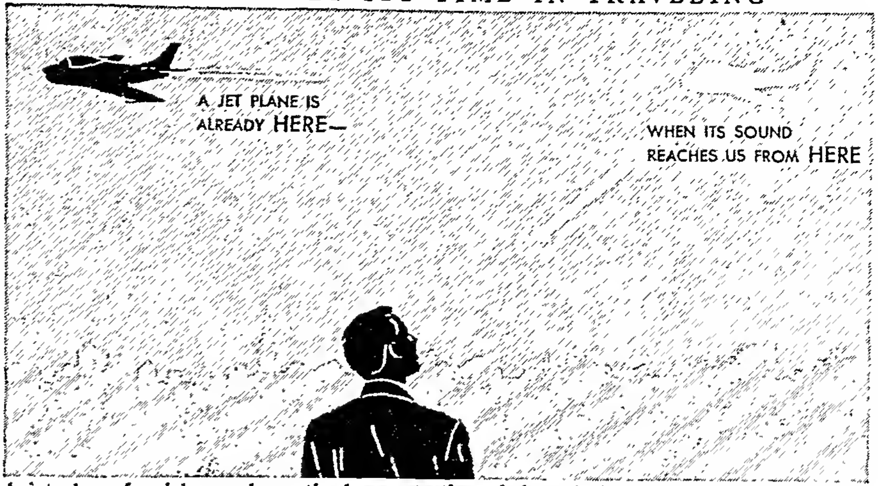
There is an old catch question concerning the definition of sound: If a tree falls in a forest far from any human being, does its crash make any noise? The answer, of course, depends on how we define sound. If we think of it as the waves that are carried by the air, the answer is yes. Wherever there are sound waves there is sound. But if we think of sound as a sensation in the ear, the answer must be no. In that case, sound does not exist unless there is someone present to hear it. The two definitions are equally correct, and scientists sometimes use one and sometimes the other.

How Sound Is Produced and Carried

It is easy to detect the vibrations of many sound-producing objects. A radio loud-speaker, for example, vibrates strongly, especially when the volume is turned up. If we lightly touch the speaker cone we can feel its vibrations as a kind of tickling sensation in our fingertips. If we touch our throat while singing a low note, we can feel the vibrations of the vocal chords. A common experiment in physics classes is to strike a tuning fork and dip the end of it in water. The vibrating fork splashes the water about and sets up little waves that are easy to see

Sound waves are often compared with water waves, but they are actually a very different sort of wave. What they are can be seen by considering what happens when an object is set vibrating in the air. Suppose someone strikes a gong or cymbal, as in the diagram at the bottom of this page. As the gong vibrates, it alternately bends outward and inward very rapidly. This movement pushes and pulls at the air next to the surface of the metal. Air is made up of tiny *molecules*, billions of them to every cubic inch (*see* Air; Gas). Therefore, when the metal gong bends outward it crowds together those air molecules that are close to its surface. These molecules push outward against other molecules and they in turn push against still others. Thus a *compression wave* is set into motion. The wave travels outward from the gong, becoming weaker and weaker until it dies away.

SOUND TAKES ITS TIME IN TRAVELING



A jet plane furnishes a dramatic demonstration of the relatively slow speed of sound. By the time the sound of the plane reaches us, the plane itself may be miles away.

A single sound wave such as this does not actually produce a sound, of course. As the gong continues to vibrate, each outward bending of the metal sets up a new compression wave. Between each pair of compression waves is an area in which the molecules of air are spread apart more widely than normal. Such a *wave of rarefaction* corresponds to a moment in which the gong is bent inward, pulling instead of pushing the molecules. The whole series of compression and rarefaction waves traveling outward from the gong make up what we hear as sound. The sound waves travel in all directions from their source.

The Speed of Sound

Sound waves travel at a constant speed. The loudness or softness of a sound has nothing to do with the speed of sound waves. Temperature, however, does affect their speed. At room temperature (70° F.) sound travels in air at a speed of 1,129 feet a second. With each rise of one degree Fahrenheit, the speed of sound increases by a little more than one foot a second. Air pressure has little or no effect. Humidity has a slight effect, the speed of sound being somewhat greater in humid air than in dry air. Since 1,129 feet is about 1/5 of a mile, sound waves travel one mile in approximately five seconds. This explains the old device of counting seconds between a lightning flash and the thunder and dividing by five to tell how far away the lightning is.

Many other substances are better conductors of sound than air. Like all gases, air is a poor medium for sound waves. Liquids, such as water, are better; and rigid solid substances, such as iron and stone, are best of all. A graph on the following page gives the velocity of sound in various media. Sound waves travel in much the same way in liquids and solids as in air. The molecules of a liquid move about less freely than do molecules of a gas, and the molecules of a solid less freely still. Compression waves, however, are formed and transmitted in them just as in air. In a good conductor, sound not only travels faster—it also travels farther before it dies away.

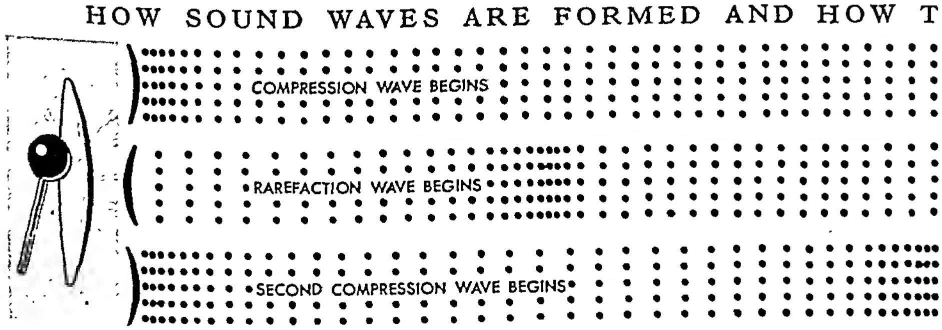
A few solids are much poorer conductors of sound than air. Rubber, cork, cotton, and felt, for example, tend to absorb sound waves rather than transmit them. For that reason such substances are used often to deaden unwanted noises.

The Pitch of Sounds

As everyone knows, some sounds are high and others are low; some are loud and others barely audible; some are pleasant and others harsh. The three basic properties of any pure sound are its *pitch*, its *intensity*, or loudness, and its *quality*.

Pitch is simply the rate at which vibrations are produced. This is usually expressed as the number

HOW SOUND WAVES ARE FORMED AND HOW THEY TRAVEL



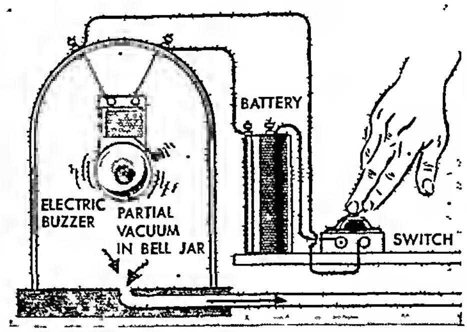
When a gong is struck, the metal first bulges outward, compressing the air molecules nearby and giving them energy.

The molecules compressed by the metal gong bump against others and set in motion a wave which travels through the air.

The first wave continues outward as a second one is formed. Between each two compression waves is a rarefaction wave.

of cycles per second. (A cycle is a complete vibration back and forth.) The number of cycles per second is the *frequency* of the tone. The higher the frequency of a tone, the higher its pitch. When a saxophone is sounding the note A above middle C, the reed in its mouthpiece is vibrating at a frequency of 440 cycles per second. Twice that frequency (880) gives a note an octave higher, and half the frequency (220) produces a note an octave lower (*see* Music).

NO SOUND IN A VACUUM



Sound waves must have a medium such as air to carry them. Here a buzzer is hooked up in a bell jar. As the air is pumped out, the sound of the buzzer grows fainter and finally dies away.

Another way to define the pitch of a tone is to give its *wave length*. The wave length of a particular tone is equal to the velocity of sound divided by the frequency of the tone. Suppose the frequency is 440. This means that 440 compression waves are formed every second. Since sound travels about 1,100 feet a second, the distance between waves is 1,100/440, or about $2\frac{1}{2}$ feet. This is the wave length of the tone.

If a source of sound is moving, sound waves are shortened in one direction and lengthened in the opposite. Such shortening and lengthening change the pitch of the tone. The whistle of a moving railroad train drops suddenly in pitch as the train passes. This is called the *Doppler effect*, from the name of the Austrian physicist who first explained it.

The human ear cannot hear all possible frequencies. Most people cannot hear any fewer than 16 cycles a second or any more than about 20,000. Music only rarely makes use of this whole range of audible frequencies. The lowest note on a piano has a frequency of 27 cycles a second and the highest note a little more than 4,000. Frequency-modulation radio stations broadcast notes up to 15,000 cycles. These can be heard only through "high fidelity" receivers.

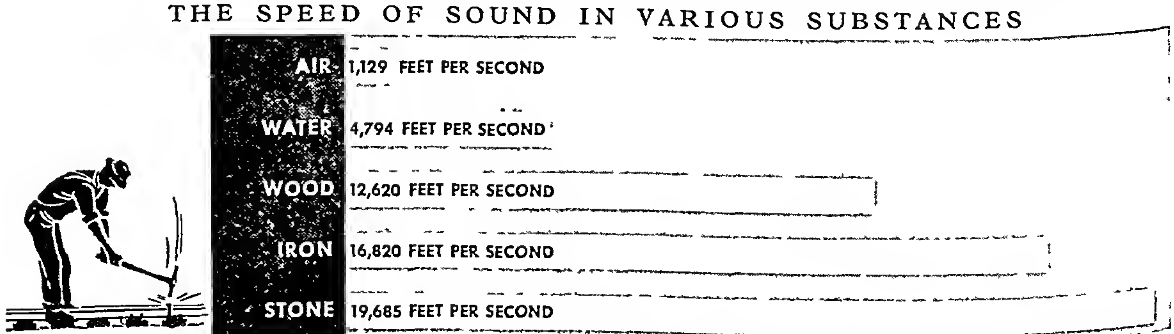
Frequencies greater than the human ear can hear are called *supersonic* or *ultrasonic* waves. A silent dog whistle is pitched at supersonic frequency. A dog hears these waves as sound though a human being does not. Extremely high frequencies of 100,000 to 500,000 cycles a second can cause strong physical and chemical reactions. They can force water and oil to emulsify, dust to collect, and gases held in liquids or molten metals to bubble out. They also destroy certain types of bacteria.

Intensity and Tone Quality

The intensity of a sound has nothing to do with its pitch. A high tone can be either loud or soft, and so can a low tone. Intensity depends upon the strength, or *amplitude*, of the vibrations producing the sound. A piano string, for example, vibrates gently if the key is struck softly. The string swings back and forth in a narrow arc and the tone it sends out is soft. If the key is struck forcefully, however, the string swings back and forth in a wider arc. The stronger vibration then produces a louder tone. The explanation of this is that a vibration of greater amplitude compresses the molecules of the air more forcefully and gives them greater energy. When a series of such strong compression waves enters the ear, our brain interprets it as a loud tone. The loudness of sounds is measured in *decibels*. On the scale used, absolute quiet is 0. The rustle of leaves is rated as 20 decibels, average street noise as 70, and nearby thunder as 120 (the top of the audible scale).

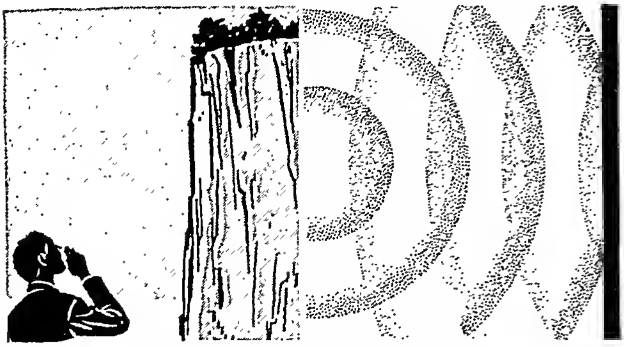
The quality, or timbre, of a sound is more complicated than pitch or intensity. The tone of a flute, everyone would agree, has a pleasant quality while the screech of a bluejay has an unpleasant one. Neither of these sounds is a simple tone. The flute may be sounding, say, A above middle C. In addition to the frequency of 440 cycles per second, however, the flute is producing higher frequencies as well. These softer and higher tones are called *overtones*. In the example of the flute, the main overtones heard are the octave and the 12th. For A, these notes are the next A above and the E above that note. These overtones harmonize well with the principal note (or *fundamental*) and account for the sweet tone of the flute. Other instruments sound different combinations of overtones which give them their special tone quality. The human voice and stringed instruments such as the violin and piano are very rich

THE SPEED OF SOUND IN VARIOUS SUBSTANCES

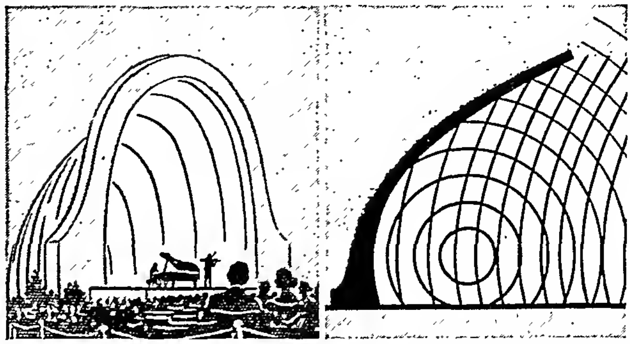


Most of the sounds we hear reach us through the air, and we tend to think of air as the "normal" medium for sound waves. It is a relatively poor conductor, however, as this graph shows. The speeds given are for a temperature of about 70° F.

HOW SOUND WAVES CAN BE REFLECTED AND FOCUSED



Sound is echoed from a cliff in much the same way that light is reflected from a mirror. The diagram at the right shows how each sound wave is turned back upon itself as it strikes a flat surface. When they return to the source an echo is heard.



Band shells for concerts in the open air are often constructed in parabolic form, as shown here. This reflects sound waves and forms them into a beam which strikes the audience in front of the shell. A headlight reflector focuses light in the same way.

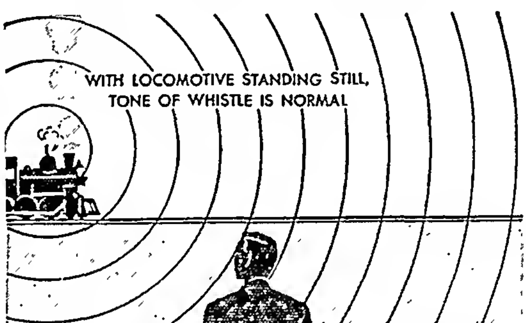
in overtones. Overtones which harmonize better than others are notes of the same scale. Musical instruments stress these overtones, and singing teachers try to make students bring them out in their voices.

Sounds we think of as harsh are combinations of tones that do not harmonize. The raucous call of a bluejay may never have been analyzed, but it is certainly a combination of extremely discordant notes. Noises of all sorts are simply miscellaneous combinations of tones. They are unpleasant because the tones which comprise them are unrelated.

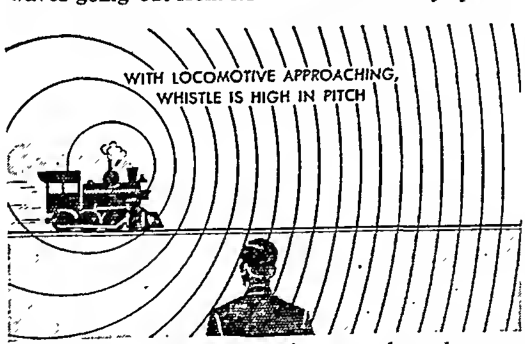
Reflecting and Focusing Sound Waves

Like light waves, sound waves can be reflected and focused. An echo is simply a reflection of sound (*see* Echo). A flat surface, like that of a cliff or wall, reflects sound better than an irregular surface, which tends to break up the sound waves. Echoes are useful in many ways. In a fog, a ship's captain can often tell whether he is near a hilly shore line by listening for echoes of the ship's whistle. Underwater *sonar* equipment uses echoes of a supersonic signal in a similar way to detect submarines. The device automatically times the echo from the submarine's hull and computes the distance (*see* Submarine). Depth finders use echoes from the ocean bottom to measure the depth of the water. The signal sent out may be of sonic or supersonic frequency.

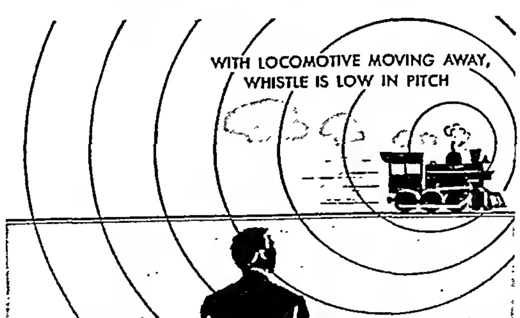
THE DOPPLER EFFECT



When a locomotive is standing still, the sound waves going out from its whistle are evenly spaced.



When the locomotive is moving toward an observer, however, the waves bunch together ahead of the source. This causes the pitch of the whistle to rise.



Just as the locomotive passes, the pitch of its whistle suddenly drops to a lower tone, for behind the locomotive the sound waves are spread apart.

A band shell focuses the sound of the band in just the same way an automobile headlight reflector focuses light. The headlight reflector and many band shells are in the shape of a *parabolic* curve. This curve has the property of reflecting spherical waves in such a way that they form a beam. The band shell concentrates the sound on the audience, preventing it from being dissipated in all directions. In practice a spherical shell works nearly as well, and most shells are spherical because they are easier to build.

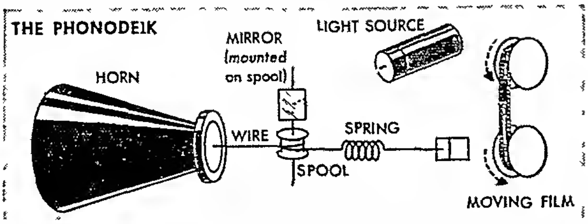
Spherical surfaces inside buildings may form "whispering galleries." Statuary Hall in the Capitol at Washington, D. C., is a famous example. If someone whispers at one spot in this chamber he can be clearly heard at another spot many yards away. Two curved surfaces on opposite sides of the room echo and focus his voice on this point.

A megaphone and a doctor's stethoscope focus sound in somewhat different ways. The sides of a megaphone hold the sound waves in and allow them to escape in only one direction. The waves thus have more energy and so are intensified. A stethoscope is a megaphone in reverse. It gathers sound waves from a relatively wide area and funnels them into a small area. This has the effect of intensifying the sound of the patient's heart.

Interference and Beats

Sound waves show other properties that resemble those

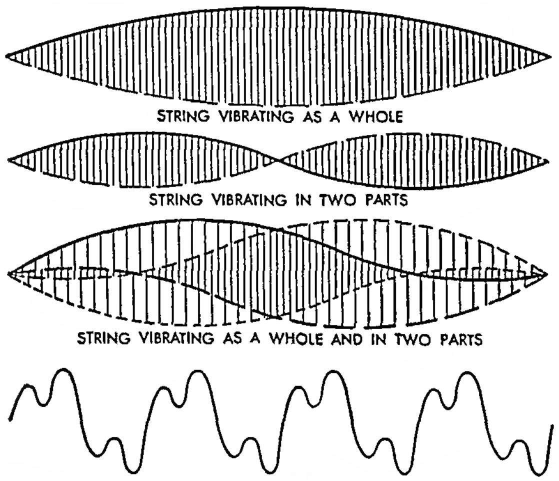
DRAWING PICTURES OF SOUND WAVES



The phonodeik, an instrument developed by Dayton C. Miller, helps to picture sound waves. Sound causes a narrow beam of light to vibrate, and the light in turn forms an image on a fast-moving strip of film.

of light. One of these is the phenomenon called *interference* (*see* Light). If an identical tone is produced by two sources, the sound waves may get "out of phase"; that is, the compression waves from one source may arrive at the listener's ear along with the rarefaction waves from the other source. If so, they cancel out one another and no sound is heard.

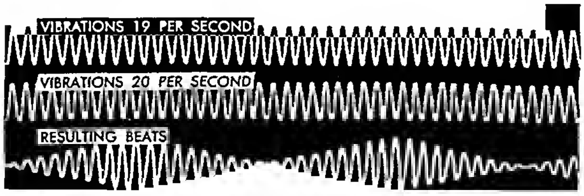
HOW OVERTONES ARE FORMED IN A STRING



At the top a string is shown vibrating in three different ways. At the bottom is a phonodeik image of the tone produced by a string vibrating as a whole and in two parts. It shows tbe fundamental and first overtone.

Interference helps in the formation of sound *beats.* If two organ pipes, for example, are tuned a few vibrations apart, they produce a throbbing tone when sounded together. If the difference is three vibrations a second, the waves will be out of phase three times in each second and will be in phase an equal number of times. When they are out of phase, there is a moment of comparative silence. When in phase, however, they reinforce each other and increase the intensity of the tone. Beats between two ranks of pipes are used in a pipe organ for certain tremolo effects.

HOW TWO TONES CAN PRODUCE BEATS



If two tones are slightly out of tune, the throbbing called beats results. These are phonodeik images of two tones one vibration apart and the beats that result when the two tones are sounded together.

Production of Musical Sounds

In an orchestra three classes of instruments are used—wind, string, and percussion instruments (*see* Musical Instruments). Each of these produces tones in a different way.

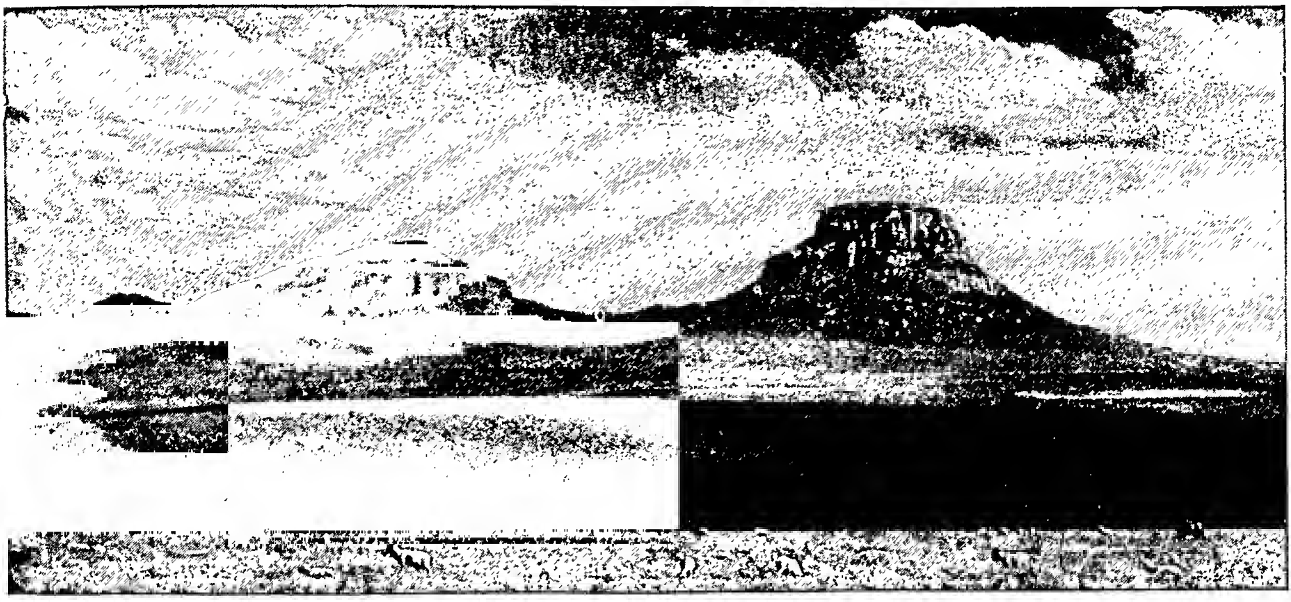
Strings are perhaps simplest to understand. The pitch of a string depends upon two things—its tension (the pull that is put upon it) and its length. The greater the tension on a string, the higher its pitch. A violin string, practically speaking, is under constant tension. The violinist raises its pitch by shortening the vibrating length of it with the fingers of his left hand. If he presses his fingertip firmly on the middle of the string, only half of the string can vibrate under the bow. It then sounds a note an octave higher than the "open" string.

When a string is bowed, plucked, or struck near one end, it may vibrate in several ways at once. It vibrates as a whole, sounding the fundamental tone. It may also vibrate in two or more parts at the same time, sounding faintly heard overtones. The vibrating sections of the string are known as *loops* and the points between these as *nodes.* A violinist obtains "harmonics" by touching the string lightly at a node, suppressing the fundamental altogether.

Most of the volume of a violin is due to *resonance.* Without the body of the violin, the strings would produce only very soft tones. The body, however, is constructed to vibrate *in sympathy* with the strings. Vibrations from a string are transmitted to the body of the instrument. Both the body and the air inside it then vibrate at the same frequency as the string. Because the wood is so much more massive than the string, it sends out more intense sound waves than the string could alone. The tones of piano strings are similarly reinforced by the piano's sounding board.

In wind instruments, resonance is even more important. The lip of an organ pipe or the mouthpiece of a trombone merely furnishes a very weak vibration. The tone is produced by the vibrating column of air inside the pipe or tube. The vibrating air forms loops and nodes just as a string does. When softly blown, a wind instrument generally sounds its fundamental. Stronger blowing breaks the air column at one or more of its nodes and so produces a higher tone. Apart from this consideration, the length of a pipe determines its pitch. A hole in the side of a pipe has the same effect as cutting the pipe off at that point. Instruments such as the flute use this principle.

Percussion instruments such as bells and chimes vibrate in exceedingly complex ways. Church bells sound many different tones at once. The true fundamental, or "hum note," is barely audible, and the "strike note" is actually the first overtone. In such bells, five of the separate tones are generally brought into tune. Tubular chimes do not sound so many overtones. The most prominent tones are the strike note and the hum note an octave lower.



Most of South Africa lies on this great plateau—the high veld. The outcroppings of rock in the background are called kopjes.

UNION *of* SOUTH AFRICA —LAND *of* AFRICAN, BOER, *and* BRITON

SOUTH AFRICA, UNION OF. The history of South Africa has been a story of constant strife. Conflicts between tribe and tribe, between black and white, and between Dutch and English culminated in the Boer War (1899–1902). Even after the Union was established in 1910 unity was not achieved. Today South Africa is still a "house divided against itself." In all international crises, notably the two World Wars, the country has been sorely divided on the political issues involved. Increasingly severe racial segregation laws have aroused bitter resentment among the African Negroes, mixed races (called *coloreds*), and Asian Indians. These peoples outnumber the European whites by more than three to one.

The Land and the Climate

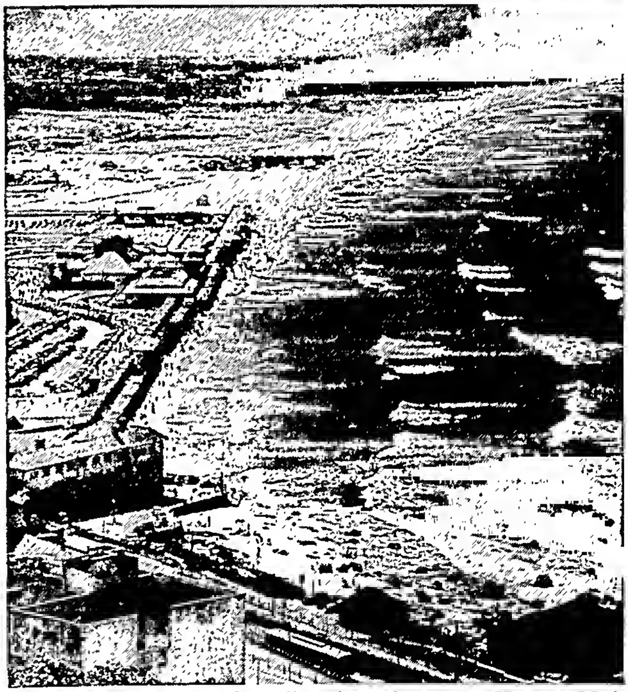
This land of unrest and tension forms the southern tip of Africa and lies between the Atlantic and Indian oceans. Ramparts of hills rise from low-lying coastal plains step upon step, with terraces of small, barren plateaus (*karroos*) between. The hills ascend until suddenly the whole vast region opens into a great plateau, the high *veld,* from 4,000 to 6,000 feet above the sea. Here the treeless, grass-covered, rolling plain stretches for miles northward toward the equator.

Location and size.—Southern tip of Africa. Greatest width, about 1,050 miles, between Atlantic and Indian oceans. Southernmost point, Cape Agulhas. Area of Union proper, 472,494 sq. mi. Population (1951 census, preliminary), 12,649,702.

Products.—Corn (mealies), wheat, barley, oats, sugar, tobacco, cotton, citrus fruits, grapes; wool, mutton, lamb, beef, hides; gold, diamonds, copper, iron, platinum, tin, lead, chrome, uranium; chemicals, clothing, furniture, processed foods.

Provinces.—Cape of Good Hope, or Cape Province; Natal; Orange Free State; Transvaal. Mandate: South West Africa.

Cities.—Johannesburg (880,014); Capetown (legislative capital, 512,822); Durban (463,120); Pretoria (administrative capital, 284,182); Port Elizabeth (199,287); Bloemfontein (judicial capital, 109,130); Kimberley (64,986).



Sandy beaches stretch for miles along the coast. Here at Muizenberg, a resort suburb of Capetown on the eastern side of the Cape of Good Hope, the waters of the South Atlantic are warmed by the Agulhas Current from the Indian Ocean.

Mountains along the eastern and southern coasts, chiefly the Drakensberg, capture the moisture of the southeast trade winds. As a result the interior and west coast are largely arid or semiarid. Here the Kalahari and Namib deserts are made even drier by prevailing westerly winds and the cold Benguela Current flowing up the west coast. The seasons are the reverse of those in the Northern Hemisphere. The summer months are from December to February.

Winter is from June to August. In the greater part of South Africa the climate is dry and bracing, with most of the rain falling in the summer. The Cape Peninsula, however, has a Mediterranean climate, with warm, dry summers and mild, rainy winters. Only a small part of the Union has sufficient rain for crops. Pasture lands prevail.

Native Plants and Animals

The high veld is grassland where the rainfall is scanty. Scattered bush and scrub grow in the semiarid karroos. Tropical and semitropical plants flourish in the Mediterranean climate of the southern Cape Province, sometimes called the "palm belt." Forests are found chiefly in the high, wet regions of Natal and in the eastern Cape Province. In the Kalahari and Namib deserts to the west, thorn and acacia trees grow among the desert bush and grasses.

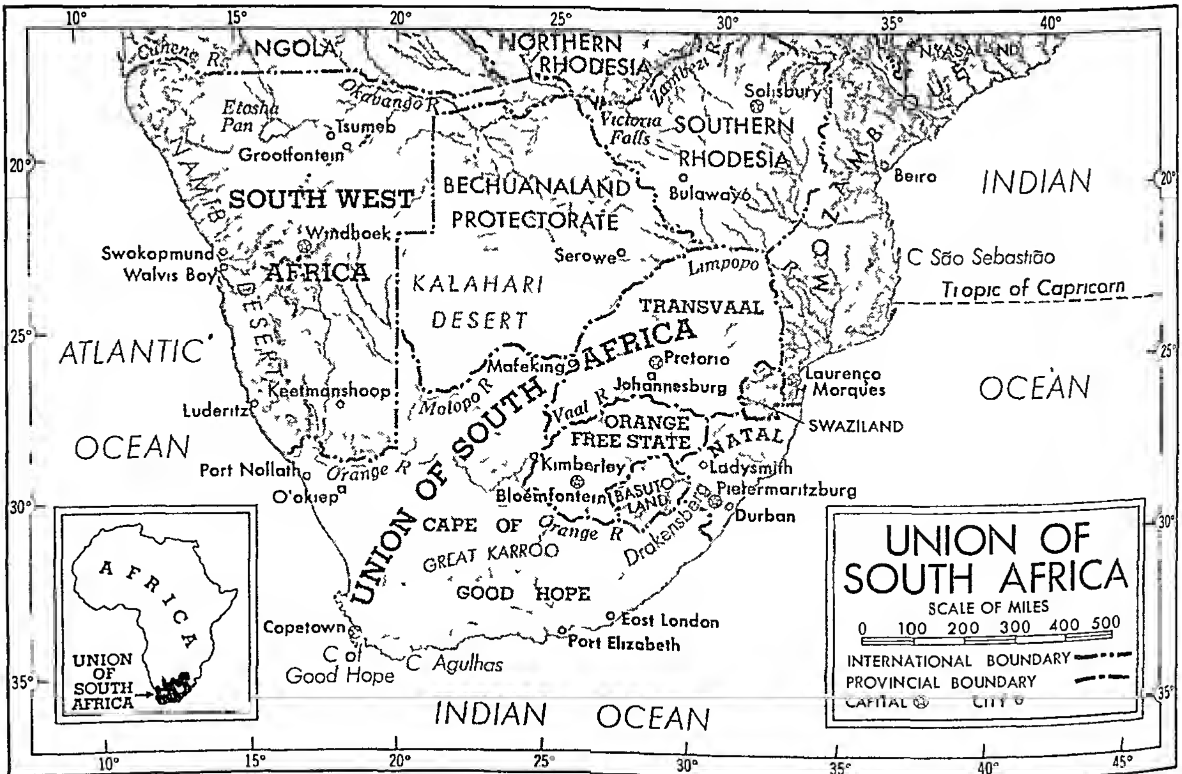
The animals that once roamed all South Africa are *now abundant only* in Kruger National Park *in the* Transvaal, in the Etosha Pan in South West Africa, and in the smaller game reserves. They include the great antelope family, zebras, giraffes, buffaloes, elephants, hippopotamuses, monkeys, and baboons. Among the meat-eaters are lions, leopards, wild dogs, hyenas, and jackals. The many birds include ostriches, vultures, hornbills, and secretary birds, which are found only in South Africa. Reptiles are represented by crocodiles, pythons, and a variety of the smaller snakes. The aardvark, golden mole, and elephant shrew are typical rodents. The termite, or white ant, is one of the many insects. (*See also* articles on animals listed here.)

The Three Major Population Groups

African Negroes make up the greater part of the Union's people. There are several hundred tribes, collectively called Bantu, including Zulu, Mashona, Matabele, Swazi, Bechuana, Basuto, Xosa, Fingo, and many others. Also of Negroid stock, but negligible in number, are Bushmen and Hottentots.

About one third of these Africans live on tribal "reserves" set aside by the government. Here only the African is permitted to occupy or own land. Most reserve lands are communally held and overcrowded The people support themselves by a primitive agriculture. The chief crop is corn (mealies). Many of the younger men work as laborers in mines and other industries of the cities. In urban areas about one half of the Africans live in controlled "locations" They are employed in mining, manufacturing, and other industries and as domestic servants. The remainder "squat" in "shanty towns" where overcrowding and slumlike conditions are serious problems African farm laborers are either paid a small wage or live on the farm, graze cattle, and cultivate land in return for working a fixed number of days.

The white, or "European," population is the second largest group. This group is divided on the basis of the Union's official languages—English and Afrikaans Afrikaans is similar to Dutch, but many German, French, and English words have been adopted. English-



The Union of South Africa, an independent member of the British Commonwealth, holds a mandate over South West Africa. Other Commonwealth territories shown on this map are the protectorates of Northern Rhodesia, Nyasaland, Bechuanaland, and Swaziland; and the self-governing colony of Southern Rhodesia Angola and Mozambique are overseas provinces of Portugal.

SOUTH AFRICAN MINERS AND THEIR FAMILIES

Africans, recruited to work in the gold mines of the Transvaal, sign contracts with their fingerprints. Mothers sit outside their homes in a controlled area called a "location." The clothing of these African women is the result of early missionary influence. They wear their distinctive turbans only after they have reached the age of 18. It is a sign of having reached maturity.

speaking South Africans are largely from Great Britain and the white dominions of the Commonwealth. Generally, they live in the cities and control most of the industries. Afrikaans-speaking South Africans are called *Afrikaners*. They are almost all descended from the Dutch, Huguenot, and German colonists who first settled South Africa. This group makes up most of the farm population. The word *boer* means farmer.

The third group is the coloreds. A colored is one who has some European blood but is not of "pure" European origin. He may vary in physical features and color from Negroid to characteristics indistinguishable from European. Most coloreds live in and around Capetown and are called Cape Coloreds. The mixed races also include Malays and some Bushmen and Hottentots. Besides the three major groups, there is a smaller Asian Indian population chiefly in Natal.

Natural Resources and Industries

South Africa has enormous mineral wealth. It produces about one half the world's annual supply of gold. Diamond production ranks second in quantity after the Belgian Congo, but first in value (*see* Diamonds; Johannesburg). Lead, zinc, and copper are mined in large quantities. The principal deposits are at O'okiep in Namaqualand and at Tsumeb in South West Africa. The coal deposits of the Transvaal and Natal yield millions of tons annually. Iron ore, platinum, and other minerals are found in smaller quantities. In a recent development uranium oxide is being extracted from the ores of the Transvaal gold mines.

The vast, high veld is used chiefly for grazing, and the Union is one of the leading wool producers of the world. Goats are raised for mohair. Hides, butter, and cheese are important exports. The ostrich farms of the Cape provide about 85 per cent of the world's plumes. Extended irrigation has increased production of grains and fruits. The largest crop is corn. Wheat, barley, and oats are also grown. On the Natal coast tobacco, sugar cane, and tea flourish. Dried, canned, and fresh fruits are exported from the Cape Province, which is also the center of the wine industry.

Manufacturing was stimulated after the first World War. The second World War spurred the growth of heavy industry. Important industries are fishing, leather tanning, tobacco manufactures, textiles and clothing, chemicals, automobiles, and furniture.

Government and Education

The Union of South Africa is a self-governing dominion of the British Commonwealth. The four provinces which comprise the Union are the Cape of Good Hope, Natal, the Orange Free State, and the Transvaal (*see also* articles on these provinces). The Union has political control of South West Africa. The government includes a senate and a house of assembly. The British sovereign is represented by a governor general; but the prime minister, as head of the majority party, is the directing head of the government. The governor general can summon or dissolve parliament and appoints the administrators of the provinces and South West Africa. There are three capitals. Pretoria, the administrative capital, is the residence of the governor general, the ministers, and the diplomatic corps. When parliament is in session the government moves to Capetown (*see* Capetown). The supreme court sits at Bloemfontein, the judicial capital. Windhoek is capital of South West Africa. The state owns the transportation system.

Elementary education is directed by the provinces. It is free and compulsory, with separate schools for European and non-European children. Higher education is controlled by the Union Department of Education. There are nine universities—Capetown, Natal, Orange Free State, Potchefstroom, Pretoria, Rhodes, South Africa, Stellenbosch, and Witwatersrand.

History of South Africa

The European discoverers of the country were Portuguese mariners looking for a route to the Indies. Bartholomew Diaz rounded the Cape of Good Hope in 1488 (*see* Diaz). Vasco da Gama made the passage to India in 1497 (*see* Gama). The first landing, in Table Bay in 1503, was made by the Portuguese, but they never attempted to settle the Cape.

THE "WHITE HOUSE" OF SOUTH AFRICA

Groote Schuur (great barn) lies on the lower slopes of Devil's Peak, near Capetown. This handsome example of Dutch colonial architecture was once the home of Cecil Rhodes. He left it in trust to be the official residence of the prime minister.

In the 17th century, the Dutch East India Company required a supply station for the long voyage to the Indies. In 1652 they sent Jan van Riebeeck to establish it. The station gradually developed into a colony. When the Dutch arrived, this almost empty land was populated only by a small group of Bushmen and Hottentots in the Cape. The Dutch imported Negro slaves from the east and west coasts of Africa. Malays and Javanese came from the Indies. There were few white women in the early days and there was considerable blending of the population. Thus there appeared in the Cape area the mixed group known as Cape Colored. Capetown became the greatest port of the Southern Hemisphere and was called the "tavern of the seas."

Before and during the 17th century, while the Dutch were penetrating northward from the Cape, there was a great migration of dark-skinned Africans southward from the vicinity of the equator. These were the peoples now collectively called Bantu. The Bantu from the north were invading South Africa at approximately the same time that the Europeans in the Cape began to move northward. Thus neither had any right to claim original possession of the country, and the incoming white man did not dispossess the black. The clash between the two races came later.

The British Gain Control

During the French Revolution and Napoleonic wars the British occupied the Cape as protectors of the Dutch. As Holland changed from side to side in the European conflict, the British evacuated and then reoccupied Capetown. Finally, after the Congress of Vienna, Britain retained possession of all South African territory thus far settled by Europeans.

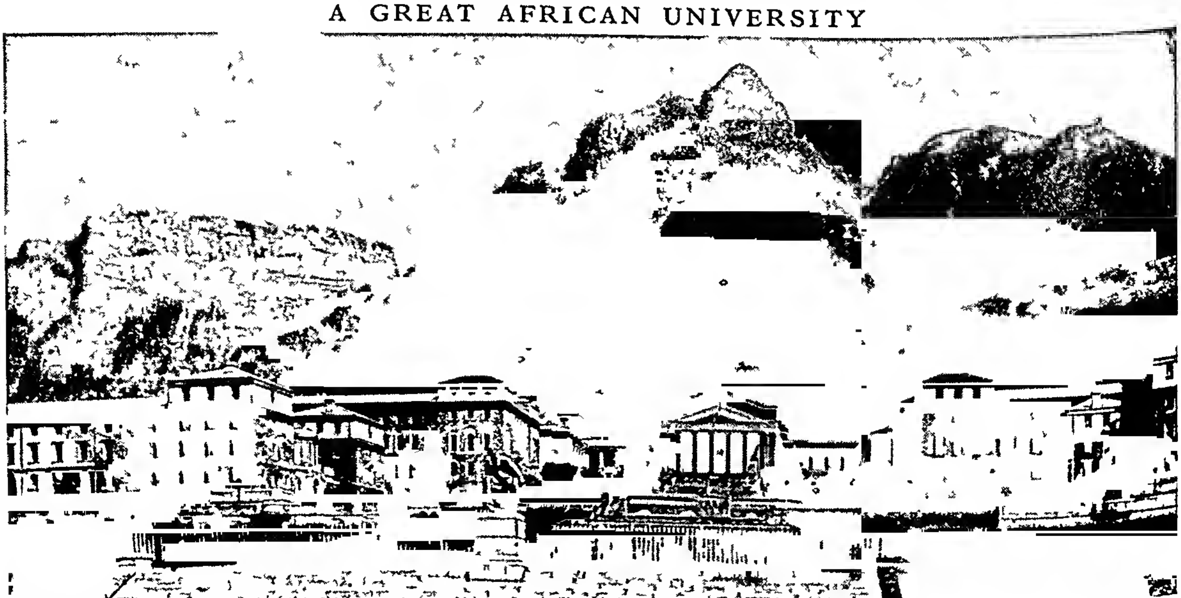
The Dutch (Boers) and English found it difficult to live together. The Dutch pattern of life had been formed during centuries when the national economy was based upon the institution of slavery. When slavery was abolished throughout the British Empire in 1833, bitter resentment spread among the Boers.

The Great Trek

Many Boers loaded their families and portable possessions upon great ox-drawn wagons, and about 1836 the Great Trek began. Large and small bands of *Voortrekkers* set off to the north and east. Facing many hardships, including hostile tribes, they crossed the Orange and Vaal rivers into the great plains of the high veld. Other bands crossed the Drakensberg into Natal. The trekkers eventually established two republics, the Orange Free State and the Transvaal, where they hoped to carry on the old Afrikaner ways of life without interference from the British In Natal they failed because the British were too firmly entrenched

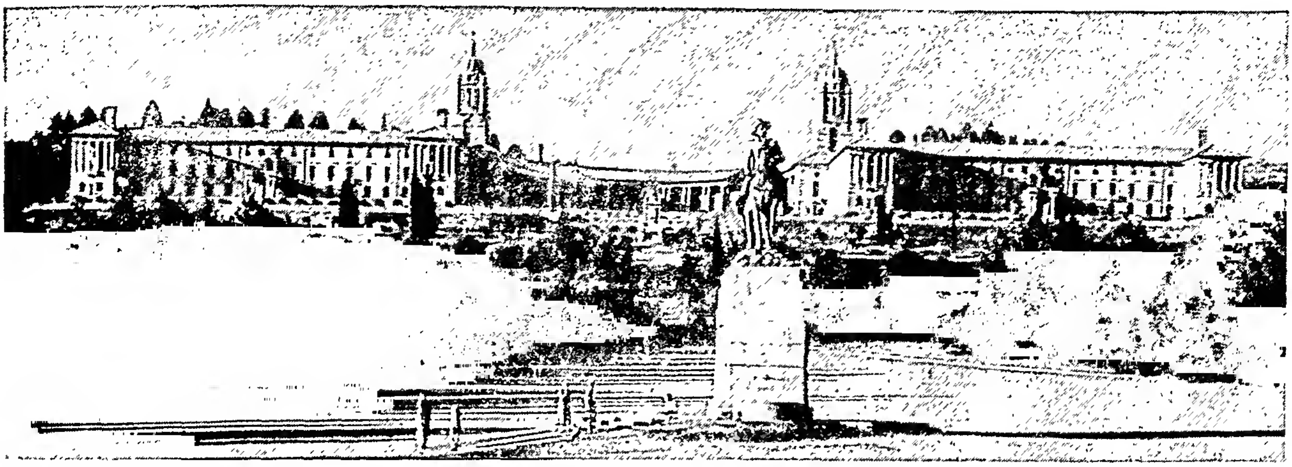
The South African conflict now involved three peoples: Boers, Africans, and British. The Boers on the

A GREAT AFRICAN UNIVERSITY



The University of Capetown is also on the Groote Schuur estate. Cecil Rhodes chose the site, and Edward VIII, then Prince of Wales, laid the foundation stone in 1925. Devil's Peak is in the center and to the left is the flat-topped Table Mountain

TWO SOUTH AFRICAN CAPITALS



In front of the Union Buildings in Pretoria, the administrative capital, stands the statue of Louis Botha, the great Boer general and first prime minister of the Union of South Africa. The buildings overlook the city from a hill called Meintje's Kop.

frontiers battled with the Africans onto whose tribal lands they had settled. The British to the south still regarded the Boers as British subjects. At one time Britain annexed the two republics. Then it restored their independence but retained control over their foreign affairs. Natal became a British colony.

Gold Is Discovered on the Rand

The discovery of gold and diamonds increased the tension mounting between British and Boers. The diamond fields of Kimberley were discovered in 1869, and the Witwatersrand gold deposits in 1886. Adventurers poured into the Orange Free State and the Transvaal, particularly from the Cape Colony and England. Johannesburg became a great city (*see* Johannesburg).

The newcomers, called *uitlanders* (outlanders) were supported by Cecil Rhodes, prime minister of Cape Colony (*see* Rhodes, Cecil). The Boers, led by President Paul Kruger of the Transvaal, tried to defend their pastoral way of life against the intruders.

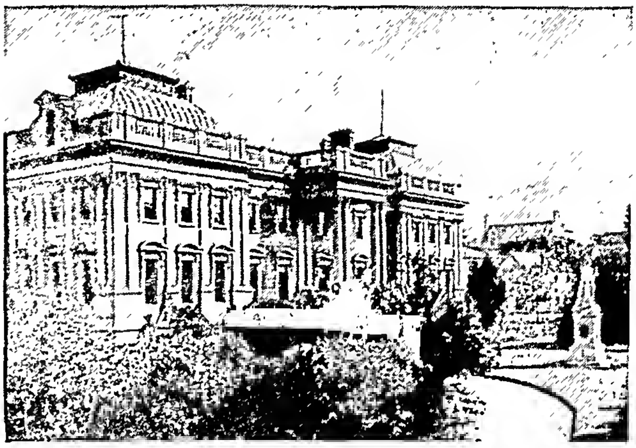
The Boer War

Jameson's ill-fated raid on the Transvaal in 1895 aroused new bitterness among the Boers. In 1899 war broke out with Great Britain. The Orange Free State joined the Transvaal and both were defeated (*see* Boer War). By the Treaty of Pretoria (1902) they lost their independence and became British colonies.

The Boer War was followed by a period of reconstruction, and in 1907 internal self-government was restored to the Boers. The South Africa Act, passed by the British Parliament in 1909, provided for the formation of the Union of South Africa. Upon its establishment (May 31, 1910), the four crown colonies became provinces. This result was achieved largely through the statesmanship of the Boer leaders Louis Botha and Jan Christiaan Smuts (*see* Smuts).

The Two World Wars

In both World Wars the Union was divided politically. In the 1914–18 conflict, while the government sided with Great Britain and its Allies, there was a strong pro-German faction within the Afrikaner element. Union forces, however, aided in clearing the Germans out of their African colonies. As a result, the Union was given a mandate over South West Africa.

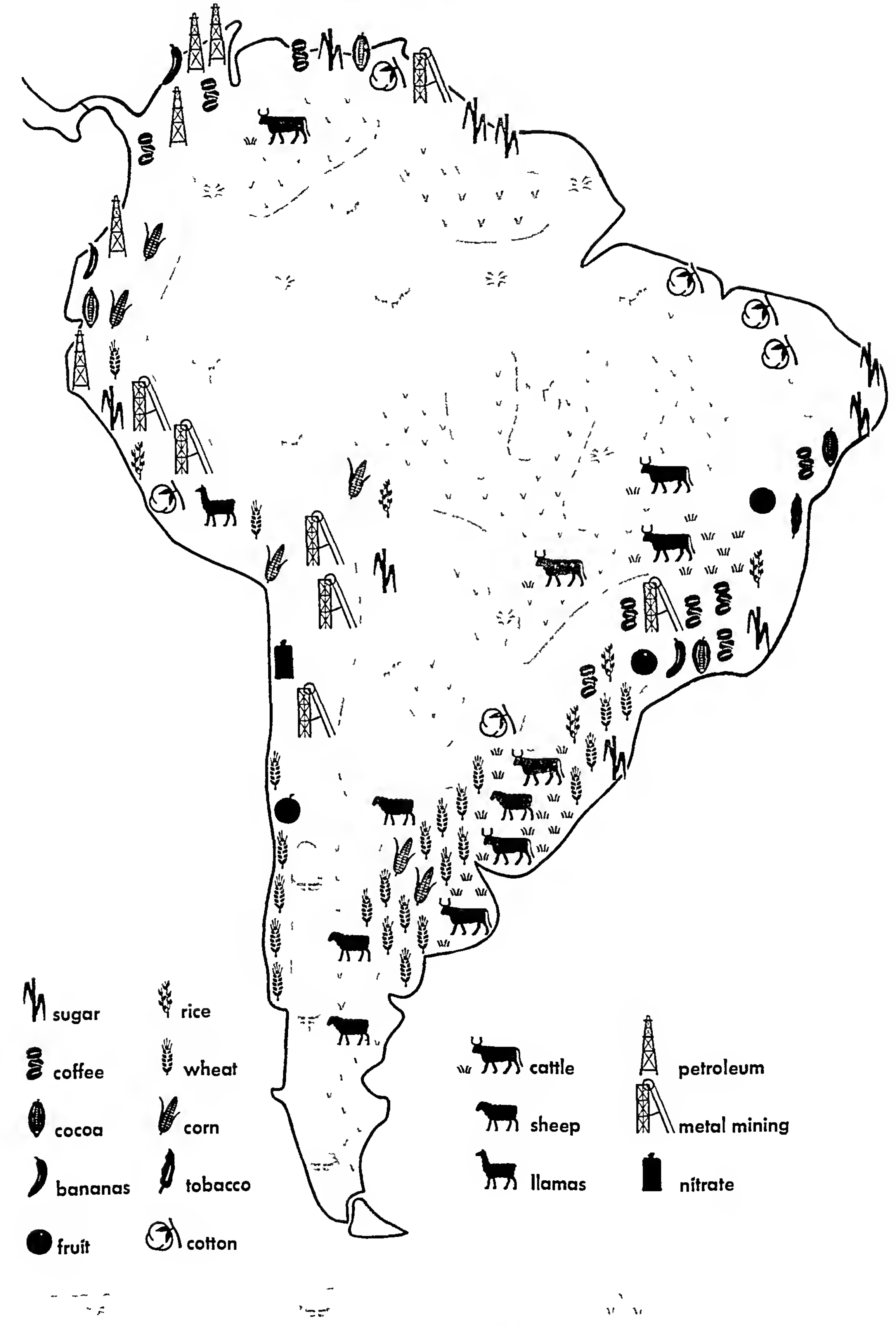


This is the House of Assembly in Capetown, the legislative capital. To the right is the memorial statue of Queen Victoria.

On the eve of the second World War, Smuts was prime minister as leader of the United party. The opposition, the Nationalist party, was headed by Gen. James B. M. Hertzog. Many of the Nationalists wanted to back the Hitler regime in the hope that if Britain were defeated a South African republic could be formed. However, by a slim majority in parliament Smuts was able to bring the Union into the war on the side of the British. There was no conscription for overseas service, but many South Africans volunteered and served in almost all theaters of war.

General Smuts played a large part in forming the United Nations. His policy of empire solidarity received a major setback in the general election of 1948. The Nationalist party, led by Dr. Daniel Malan, defeated Smuts' United party. The clamor grew to convert South Africa from a British dominion to an Afrikaner republic. The Nationalists stressed racial segregation (*apartheid*). There were bloody riots between Indians and Africans in Natal. In the election of April 1953, the Nationalists increased their majority in the House of Assembly. Their platform called for more rigid segregation of races and measures to prevent the Supreme Court from voiding segregation laws.

South America Use of Land



Prepared for Compton's Pictured Encyclopedia
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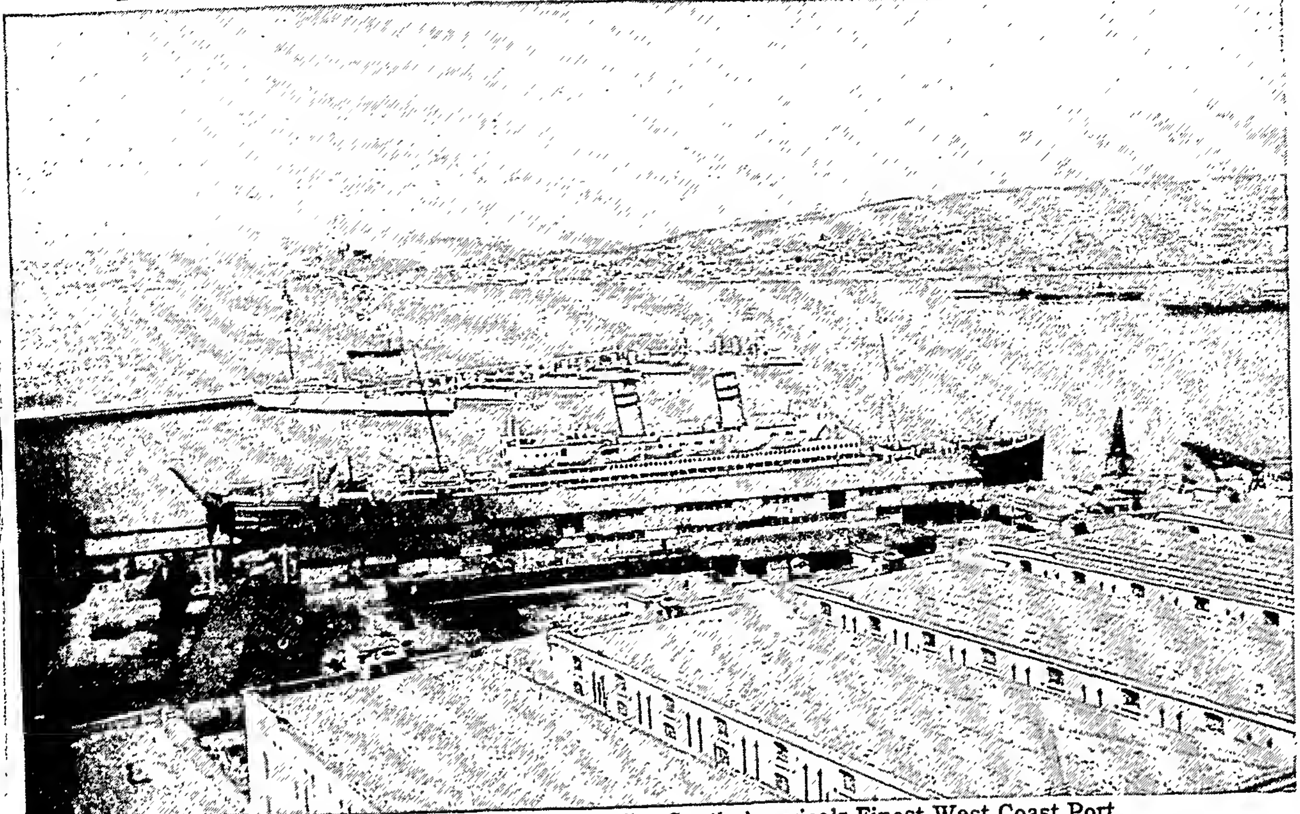
The SOUTHERN HALF *of the* NEW WORLD



Valparaiso, "Pearl of the South Pacific"—South America's Finest West Coast Port

SOUTH AMERICA. The traveler who goes from the United States or Canada to South America finds scenes and people strikingly different from those of his own land. He sees mountains far higher than the Rockies and rivers immensely greater than the Mississippi or the St. Lawrence. He gets glimpses of rain-drenched tropical forests almost as large as the United States without Alaska. In the western mountains he finds queer animals of the camel family, called llamas, carrying goods over narrow winding trails. In the Amazon forest he may see enormous snakes 20 feet long, butterflies a foot across, beetles six inches long, sloths that live upside down in the trees, chattering monkeys, slinking pumas and jaguars, gorgeously colored parrots, snow-white egrets, and a host of other unfamiliar animals.

He will be struck too by differences in the people and their ways of living. Indians or people of part-Indian blood live almost everywhere, often outnumbering the whites. In Brazil there are fewer Indians, but more Negroes. The white people too are different from the typical inhabitants of the United States and Canada. They speak Spanish, except in Brazil, where the language is Portuguese; and many of them have olive complexions and black hair.

The magnificent cities, with their cosmopolitan architecture, look more like the great cities of the Old World than of the New. Splendid public buildings in the Spanish style, wide tree-lined central avenues, parks, and plazas ablaze with flowers—these remind one of European cities. Here and there are skyscrapers telling of North American influence. Houses of the well-to-do are built around a central patio (courtyard), as in Spain. Most of the working people live in one-story houses set close together. But modern apartment buildings are rapidly springing up in the bigger cities.

The traveler observes, though, that in the entire continent there are few cities, in comparison with

Extent.—Greatest length, from Cape Gallinas (Colombia) to Cape Horn, about 4,600 miles; greatest width, from Cape Branco (Brazil) west to Point Pariña (Peru) about 3,200 miles. Area, variously estimated at from 7,200,000 square miles to 7,310,800 square miles. Population, estimated at more than 109,000,000.

Highlands, Lowlands, and Waterways.—Cordilleras in north and west (Aconcagua, 22,835 feet); Guiana Highlands, Brazilian Highlands, Patagonian Plateau, in west. Orinoco, Amazon, and Paraguay-Paraná river basins. Largest lake, Titicaca (3,800 square miles).

Political Divisions and Capitals.—Republics: Argentina (Buenos Aires), Bolivia (Sucre and La Paz), Brazil (Río de Janeiro), Chile (Santiago), Colombia (Bogotá), Ecuador (Quito), Paraguay (Asunción), Peru (Lima), Uruguay (Montevideo), Venezuela (Carácas). Colonies of European nations: British Guiana (Georgetown), Dutch Guiana, or Surinam (Paramaribo). Overseas department of France: Guiana (Cayenne).

Chief Islands.—Falklands (occupied by Great Britain but claimed by Argentina), Tierra del Fuego (Argentina and Chile), Chilean Archipelago, Juan Fernandez (Chile), Galápagos (Ecuador), Curaçao and Aruba (Netherlands), Trinidad and Tobago (Great Britain), Cayenne (France).

Chief Exports.—Wheat, corn, flaxseed, coffee, cacao, tobacco, cotton; meat, wool, hides and skins; quebracho, vegetable ivory and other nuts, carnauba wax, rubber, balata, cabinet woods; petroleum, copper, tin, nitrate, iron, silver, gold, diamonds, emeralds.

Other Products.—Oats, barley, rice, beans, potatoes, manioc, fruits, sugar, *yerba maté;* flour, petroleum products, textiles and clothing, hats, shoes, lumber and furniture, cigarettes, cement, glass, pottery, soap, matches.

Imports.—Iron and steel manufactures, machinery, railroad and mining equipment, agricultural implements and machinery, automobiles and trucks, lumber, petroleum, coal, textiles and clothing, radios and other electrical equipment, prepared foods and beverages, sewing machines and other household equipment.

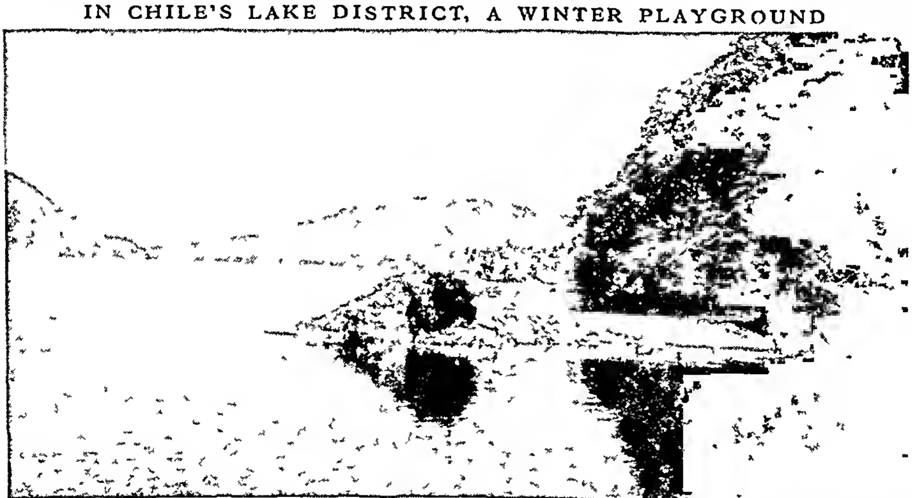
the United States. These cities, large as a few of them are, have only a small fraction of the entire population, whereas more than half of the people of the United States live in cities. He also learns that more than two-thirds of the people of South America depend on agriculture for their living, whereas in the United States less than a fifth of the people live on farms

As he travels inland from the various seaports, the visitor notices other great differences. There are few small farms. Most of the agricultural lands are divided into vast estates (*haciendas* or *estancias*) covering thousands of acres, or even hundreds of square miles. Except in Argentina, Uruguay, and part of Brazil, there are no great railway networks to make it easy for the people to travel and transport goods. Motor roads are few and short, compared to those of the United States; and motor transport outside the great cities is in its infancy. When the South American businessman wants to visit a neighboring country, he probably travels by air, since all the capitals are linked by excellent airplane service.

South America is a continent of vast resources and opportunities which no one can reckon. It has given mankind potatoes, rubber, quinine, and many other useful plant products. It supplies most of the world's coffee, and a large part of the meat, wheat, corn, and cacao that enter into world trade. Its minerals have enriched nations for four centuries. The world relies on this continent for a considerable proportion of its petroleum, nitrates, tin ore, aluminum ore (bauxite), copper, manganese, and industrial diamonds. (*See* pictograph on page 246.)

Yet the development of South America has scarcely begun. It has room for millions of people from overcrowded parts of the earth. It has millions of acres of potential crop and pasture land to be occupied. Buried in its rocks is a wealth of minerals still to be discovered and worked. Its forest resources have hardly been touched.

IN CHILE'S LAKE DISTRICT, A WINTER PLAYGROUND



The old snow-crowned Osorno volcano, rising from the emerald waters of Lake Llanquihue, is one of the favorite skiing grounds of Chileans. It is about 600 miles south of Santiago.

Can these possibilities be realized? Or are the obstacles of climate, mountain, jungle, and human character so great that we can look for no remarkable advances, at least in the near future? These are questions that the world is asking. Before we can attempt to answer them, we must know something of the physical setting of the continent, its climates, its plants and animal life, its peoples, its commerce, and its history.

Physical Setting: Comparison with North America

IN SHAPE and size, South America is much like its sister continent. It is a vast triangle, broad in the north and tapering to a narrow tip in the south. It extends about 4,600 miles from north to south and 3,200 miles from east to west, against 4,500 miles and 3,000 miles respectively for North America. In area it is smaller by about an eighth.

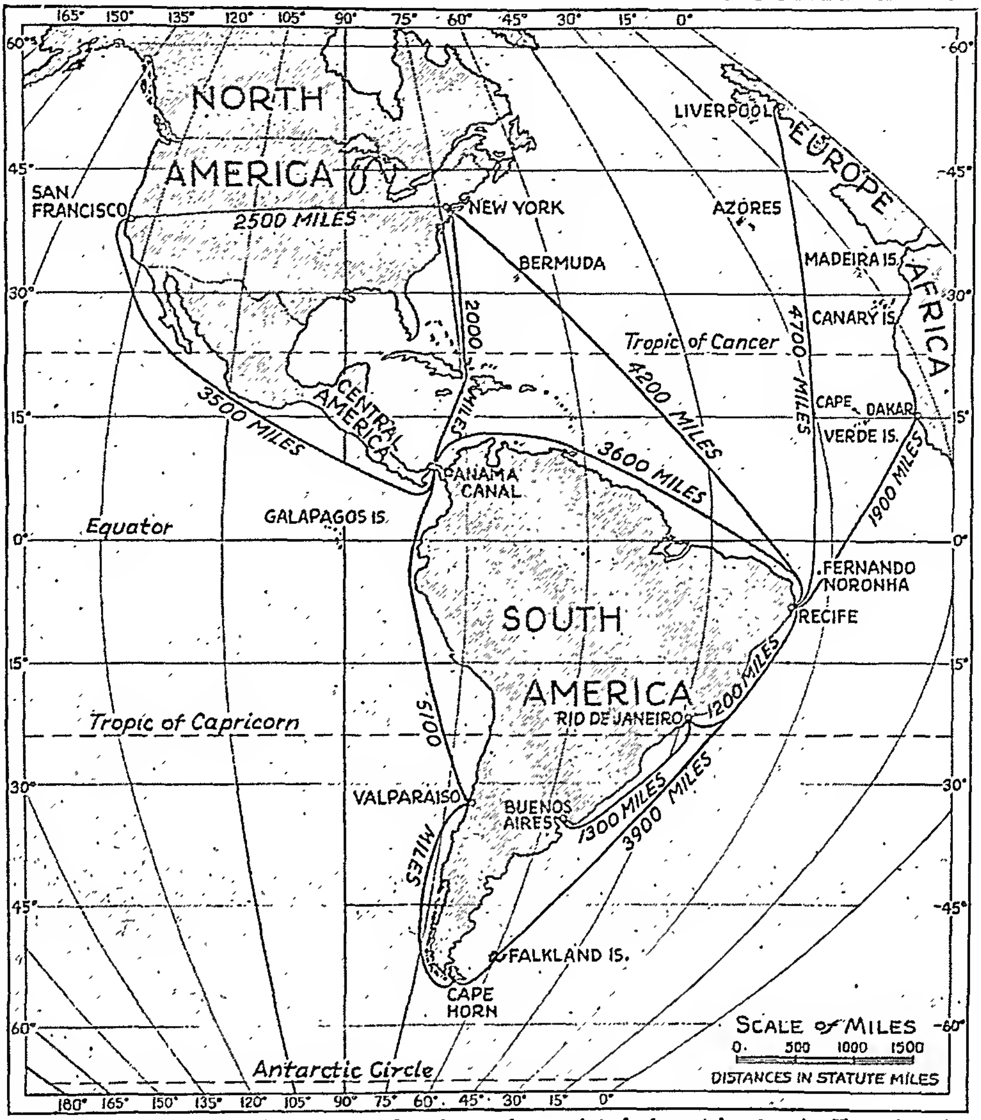
In general ground plan as well, the two continents are somewhat alike. Both have great ranges of high young mountains in the west. Both have extensive areas of old worn-down mountains in the east. And both have vast interior plains drained by great river systems. But the South American coast line is far more regular. Around much of the continent the mountains rise abruptly from the sea, with few good harbors, and little or no coastal plain to invite settlers. The interior plains are mostly tropical forest, and the western mountains are higher and more rugged than the western mountains of North America

The Great Barrier —the Andes

The Andes are the most formidable mountain barrier on the globe Though they are not so high as the Himalayas, they constitute a greater obstacle because they stretch for a total distance of 4,500 miles. They are a far more difficult barrier than the Rockies of North America, for two reasons. First, they climb steeply from the Pacific on the west and from the interior lowlands on the east. Second, they are much higher than the Rockies. Throughout most of their length, even the passes, valleys, and plateaus are almost as high as the tallest peaks of the Rockies. Railroads in the Andes are tremendously expensive to build and operate. Only the most necessary lines can be built to serve capital cities and the richest mining districts

Thus the Andes cut South America into two almost completely isolated sections. Here is an example of what this means. The seacoast of Ecuador is in one

SOUTH AMERICA'S RELATIONS TO OTHER CONTINENTS



This map shows how South America makes the southern point of a huge triangle, with North America to the northwest and northern Africa and Europe to the northeast. Notice that nearly all of South America is east of the 75th meridian of longitude, which passes near New York City and that its eastern tip is only 1,900 miles from Africa. All ports on the east coast, south of Recife, are about equally distant from western Europe and the North Atlantic ports of the United States.

lace only about 200 miles from a branch of the Amazon. But goods can be shipped several thousand miles around by sea to the mouth of the Amazon, and then up the river, at less cost and in less time than would be needed to send the shipment 200 miles over the mountains. Life in the two portions of South America has therefore developed almost as though South America were two continents.

But the greatest point of difference between the two continents, and the one which explains most of their other contrasts in plant life, animal life, and human activity, is their position with regard to the Equator. The widest part of North America and about three-fourths of its area lie in the middle latitudes, far north of the Equator. But the broadest part of South America is near the Equator, and three-fourths of its area lies within the tropics. Three-fourths of North America feels the stimulating effects of a climate favorable to human activity. In three-fourths of South America human activity is slowed down by tropical heat and white men find it hard to live. This is one of the reasons why it has only about half as many people as North America.

Influence of the Physical Setting on Human Life

THE PEOPLE of South America and their ways of living contrast just as sharply with those of the United States and Canada as do the land and the climate. North of the Rio Grande the white men have taken over the entire continent from the Indians and pushed most of the few remaining Indians into reservations. In South America Indians and *mestizos* (people of mixed Indian and white blood) form a large share of the population. Except for tribes living in primitive communities, the Indians make a living by working for white people. They till the soil, tend the stock, work on the plantations, dig the minerals, and build the roads and railways. Where roads and railways are lacking they transport unbelievably large loads on their own backs or drive the trains of pack animals.

Much of this difference in the character of the population is due to the contrasting opportunities offered to white settlers by the two continents. In North America, many fine harbors and rivers gave access to a land much like northwestern Europe in climate and suitability for agricultural use. When it was cleared of trees, it made farming land that people from northwestern Europe knew how to work. These conditions attracted humbler folk such as farmers, sailors, and fishermen; and the governments in the homelands encouraged settlers of this kind to come with their families.

When white men first discovered South America, the most alluring sources of wealth were deposits of gold and silver in the high mountains of Peru and Chile

SOUTH AMERICAN TEA

Yerba maté is the favorite beverage of many Latin Americans. The powdered herb is steeped in hot water in a gourd (*maté*) and drunk through a tube called a bombilla.

near the west coast. The Indians who were already in the land knew how to work the mines, and how to produce food, clothing, and other necessities for the miners. The Spaniards therefore enslaved the Indians to do all this, and the opportunities for white men were correspondingly limited.

On the Caribbean coast and in Brazil, a similar condition grew out of the hot wet climate. Such a climate is not favorable for white men working their own land; but the land could be worked profitably with Negro slaves. So African slaves were brought in; and here too opportunities for white workers were limited.

White, Indian, and Mestizo Countries

The country where the Indians make up the smallest fraction of the population lies in the grasslands of the south. Here, in Argentina, the whites found a climate and a soil which stimulate effort. Hence, when European demand for Argentine grain and meat arose in the 19th century, the whites pushed the Indians aside and seized the opportunities for themselves. When growth of business created a demand for more labor, they preferred to meet the demand by admitting white immigrants, particularly from Italy. Thus Argentina became the South American country which most resembles the United States in being peopled largely by whites. Uruguay too, with its fine climate and ranching land, has become a white man's country, though Indians are still numerous in the subtropical northern and northeastern portions. Brazil also has attracted white settlers, especially in the southeastern portion; but the white population makes up only about half the total. Chileans are predominantly European. The mingling of Indian strains is disappearing. In all other nations, Indian and mestizo elements outnumber white. In Colombia, Venezuela, and Paraguay mestizos are in the majority. The Indian population is largest in Peru, Ecuador, and Bolivia. Exact percentages of Indian, mestizo, Negro, and white elements are not known for statistics are incomplete and unreliable.

CASSAVA, BREAD OF THE TROPICS

The roots of the cassava or manioc are the chief crop of the natives in the hotter parts of South America. The bitter variety, which is the more common, contains a poison which must be extracted before it is made into flour.

Structure of the Land and the Main Forces that Shape the Climate

SOME OF the larger differences between the regions of South America have already been suggested To understand these, and the many smaller differences, it is necessary to look more carefully at the structure of the land and at its many different types of climate

South America began in the early days of the earth as a chain of great mountain islands. They stretched from what is now the Caribbean Sea to Cape Horn. The northernmost of these old islands still hold their summits well above sea level, as the highlands of Guiana and Brazil. The third, far to the south, is the Patagonian Plateau, which occupies the continent's southern tip.

COCA LEAVES

Everywhere in the highlands of Peru and Bolivia the Indians constantly chew the leaves of the coca shrub as a stimulant

Later in the history of the earth, after the Rocky Mountains of North America had been formed, some vast convulsion pushed up a towering range of mountains far to the west and north of the old islands. This range is the Andes, which swings in a huge bend running first southwest, then southeast, and finally straight south to the tip of the continent Material washed down from these mountains has since built a sloping plain out to the Atlantic Ocean between the old mountain islands.

The Rivers and the Coast Line

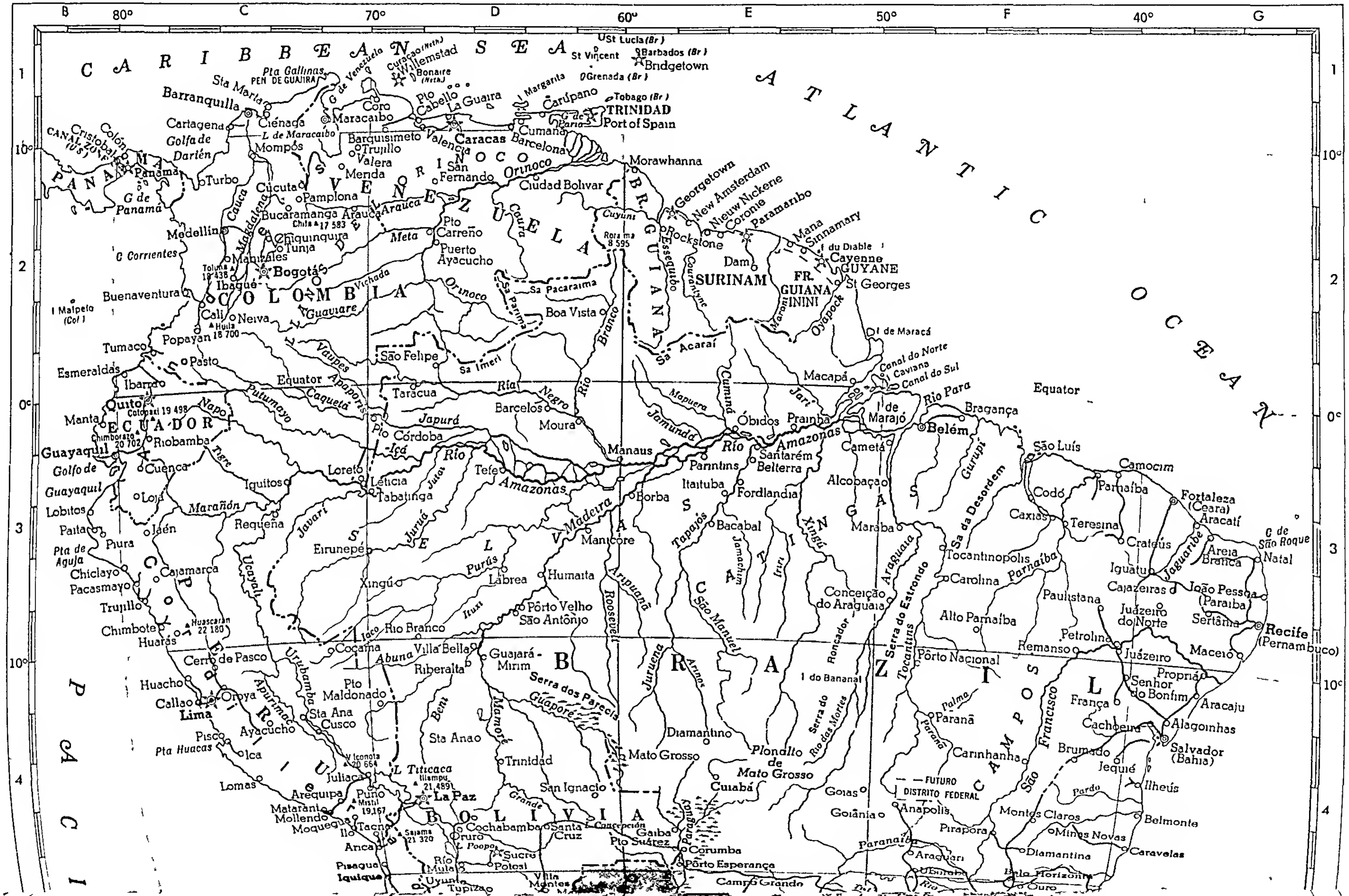
The fact that most of the continent slopes east from the Andes to the Atlantic explains why all the large rivers flow into the Atlantic. And the existence of the old highlands explains why the river systems are organized as they are. The rivers flow along the lowest land they can find, which is between the highland groups Since only three major gaps of this sort exist, most of the drainage combines into three major river systems. These systems flow into the Atlantic through the Orinoco, the Amazon, and the Rio

Continued on page 258

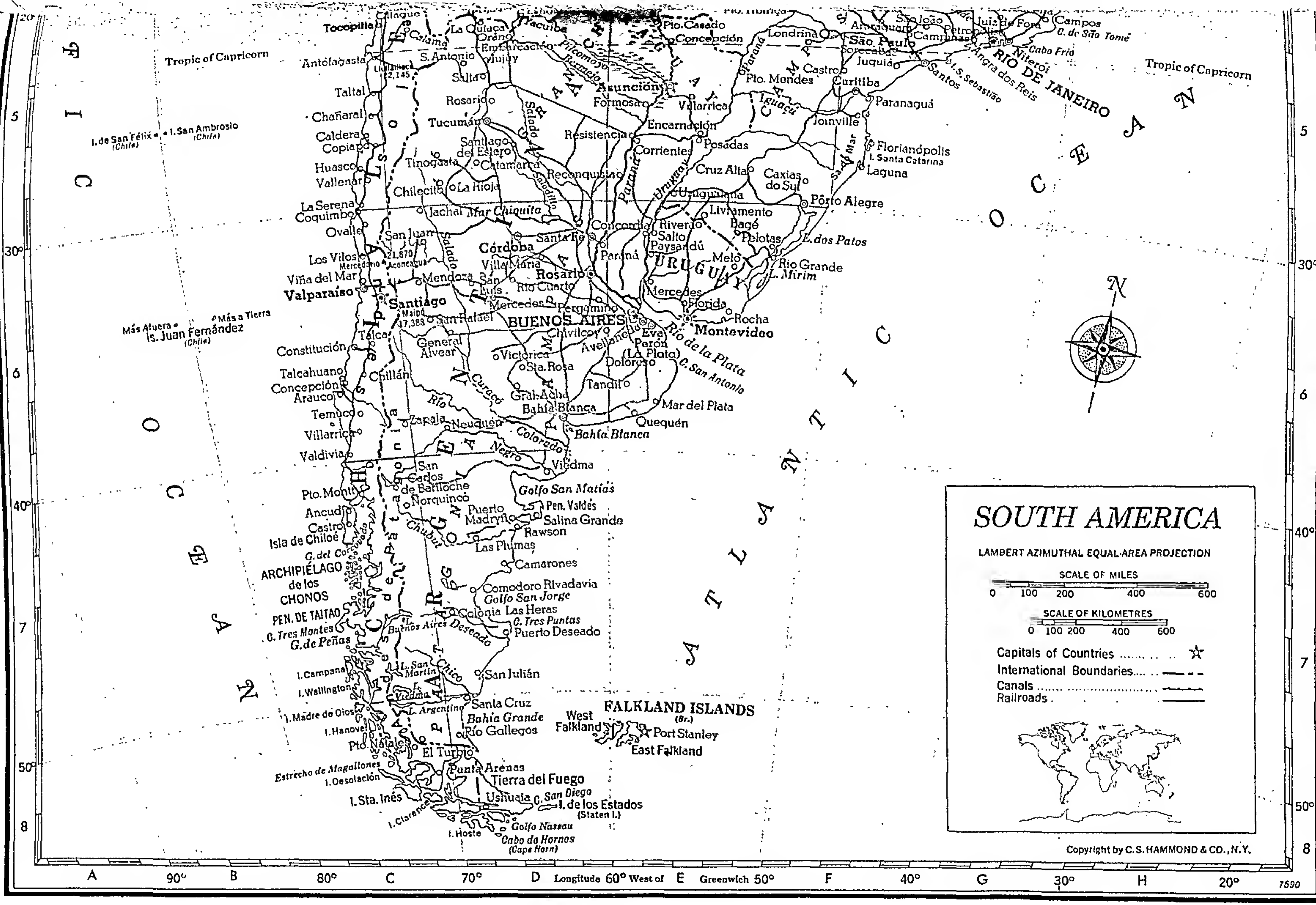
SOUTH AMERICA*

Abunã (riv.)		D 4
Acaraí (mts.)		E 2
Aconcagua (mt.)		D 6
Aguja (pt.), Peru		B 3
Alagoinhas, Braz.	21,605	G 4
Alcobaça, Braz.	1,307	E 3
Alto Parnaíba, Braz.	1,002	F 3
Amazonas (riv.), Braz.		D,E 3
Anápolis, Braz.	18,688	F 4
Ancud, Chile	6,410	C 7
Andes (mt. range)		C 2-6
Andes de Patagonia (mt. range)		C 7
Angra dos Reis, Braz.	5,464	F 5
Antofagasta, Chile	62,272	C 5
Apaporis (riv.), Col.		C 3
Apurimac (riv.), Peru		C 4
Aracaju, Braz.	68,686	G 4
Aracati, Braz.	9,123	G 3
Araguaia (riv.) Braz.		F 3
Araguarí, Braz.	25,789	F 4
Araraquara, Braz.	34,671	F 5
Arauca, Col.	1,871	C 2
Arauca (riv.)		D 2
Arauco, Chile	3,537	C 6
Areia Branca, Braz.	7,643	G 3
Arequipa, Peru	60,725	C 4
Argentina	15,893,827	D 6
Argentino (lake), Arg.		C 8
Arica, Chile	18,947	C 4
Arinos (riv.), Braz.		E 4
Aripuanã (riv.), Braz.		E 3
Asunción (cap.), Para.	109,228	E 5
Avellaneda, Arg.	278,621	E 6
Ayacucho, Peru	16,642	C 4
Bacabal, Braz.	4,877	E 3
Bagé (Bajé), Braz.	35,340	E 6
Bahía (Salvador), Braz.	395,993	G 4
Bahía Blanca, Arg.	112,597	D 6
Bananal (isl.), Braz.		E 4
Barbacena, Braz.	25,768	F 5
Barcelona, Ven.	26,446	D 2
Barcelos, Braz.	904	D 3
Barquisimeto, Ven.	105,080	D 2
Barranquilla, Col.	279,000	C 1
Belém (Pará), Braz.	230,181	F 3
Belmonte, Braz.	5,562	G 4
Belo Horizonte, Brazil	346,207	F 4
Belterra, Braz.		E 3
Beni (riv.), Bol.		D 4
Bermejo (riv.), Arg.		D 5
Blanca (bay), Arg.		E 6
Boa Vista, Braz.	5,125	D 2
Bogotá (cap.), Col.	645,255	C 2
Bolivia	3,028,031	D 4
Borba, Braz.	1,030	E 3
Bragança, Braz.	5,580	F 3
Branco (riv.), Braz.		D 2
Brazil	52,645,479	E 4
British Guiana	375,701	E 2
Brumado, Braz.	3,098	F 4
Bucaramanga, Col.	73,000	C 2
Buenaventura, Col.	23,000	C 2
Buenos Aires (cap.), Arg.	2,982,580	D 6
Buenos Aires (lake)		C 7
Cachoeira, Braz.	11,088	F 4
Cajamarca, Peru	14,290	C 3
Cajazeiras, Braz.	10,025	F 3
Calama, Chile	12,955	D 5
Caldera, Chile	1,525	C 5
Cali, Col.	†259,100	C 2
Callao, Peru	84,438	C 4
Camarones, Arg.		D 7
Cametá, Braz.	3,630	E 3
Camocim, Braz.	8,540	F 3
Campana (isl.), Chile		C 7
Campinas, Braz.	101,746	F 5
Campo Grande, Braz.	32,848	E 5
Campos, Braz.	63,384	F 5
Campos (region), Braz.		F 4
Caquetá (riv.), Col.		C 3
Caracas (cap.), Ven.	487,903	D 2
Caravelas, Braz.	2,726	G 4
Carinhanha, Braz.	1,850	F 4
Carolina, Braz.	4,861	F 3
Cartagena, Col.	125,600	C 1
Carúpano, Ven.	30,684	D 1
Castro, Braz.	6,316	E 5
Castro, Chile	6,283	C 7
Catamarca, Arg.	31,067	D 5
Catingas (region), Braz.		E 3
Cauca (riv.), Col.		C 2
Caura (riv.), Ven.		D 2
Caviana (isl.), Braz.		F 2
Caxias, Braz.	14,846	F 3
Caxias do Sul, Braz.	32,158	E 5
Cayenne (cap.), Fr. Guia.	10,961	E 2
Ceará (Fortaleza), Braz.	213,604	G 3
Cerro de Pasco, Peru	17,882	C 4
Chaco (region)		D 5
Chañaral, Chile	2,562	C 5
Chiclayo, Peru	31,539	B 3
Chico (riv.), Arg.		D 7
Chile	5,930,809	C 6
Chilecito, Arg.	6,121	D 5
Chillán, Chile	52,576	C 6
Chiloé (isl.), Chile	78,335	C 7
Chimborazo (mt.), Ec.		B 3
Chimbote, Peru	4,243	B 3
Chiquinquirá, Col.	7,000	C 2
Chiquita (lake), Arg.		D 6
Chita (mt.), Col.		C 2
Chivilcoy, Arg.	23,386	D 6
Chonos (archipelago), Chile		C 7
Chubut (riv.), Arg.		D 7
Ciénaga, Col.	23,000	C 1
Ciudad Bolívar, Ven.	31,009	D 2
Clarence (isl.), Chile		C 8
Cocama, Peru		C 4
Cochabamba, Bol.	80,795	D 4
Codó, Braz.	6,159	F 3
Colombia	11,266,075	C 2
Colonia las Heras, Arg.		D 7
Colorado (riv.), Arg.		D 6
Comodoro Rivadavia, Arg.	25,651	D 7
Conceicão do Araguaia, Braz.	1,389	E 3
Concepción, Para.	18,178	E 5
Concepción, Chile	119,887	C 6
Concepción (lake), Bol.		D 4
Concordia, Arg.	52,213	E 6
Constitución, Chile	8,285	C 6
Copiapó, Chile	19,535	C 5
Coquimbo, Chile	24,962	C 6
Corcovado (gulf), Chile		C 7
Córdoba, Arg.	369,886	D 6
Coro, Ven.	28,367	D 1
Coronie, Sur.	1,019	E 2
Corrientes, Arg.	56,544	E 5
Corrientes (cape), Col.		C 2
Corumbá, Braz.	19,211	E 4
Cotopaxi (mt.), Ec.		C 3
Courantyne (riv.)		E 2
Crateús, Braz.	7,615	G 3
Cruz Alta, Braz.	19,824	E 5
Cúcuta, Col.	†101,000	C 2
Cuenca, Ec.	39,983	C 3
Cuiabá, Braz.	24,119	E 4
Cumaná, Ven.	46,416	D 2
Cuminá (riv.), Braz.		E 3
Curacó (riv.), Arg.		D 6
Curitiba, Braz.	141,349	F 5
Cusco, Peru	40,657	C 4
Cuyuni (riv.)		E 2
Dam, Sur.		E 2
Darién (gulf), Col.		C 2
Deseado (riv.), Arg.		D 7
Desolación (isl.), Chile		C 8
Desordem (mts.), Braz.		F 3
Diable (Devil's) (isl.), Fr. Guia		E 2
Diamantina, Braz.	10,177	F 4
Diamantino, Braz.	540	E 4
Dolores, Arg.	14,438	E 6
East Falkland (isl.), Falk. Is.		E 8
Ecuador	3,202,757	C 3
Eirunepé, Braz.	1,757	C 3
El Turbio, Arg.		C 8
Embarcación, Arg.	3,303	D 5
Encarnación, Para.	17,779	E 5
Esmeraldas, Ec.	13,169	B 2
Essequibo (riv.), Br. Guia.		E 2
Estados (Staten) (isl.), Arg.		D 8
Estrondo (mts.), Braz.		F 3
Eva Perón (La Plata) Arg.	207,031	E 6
Falkland (Malvinas) (isls.)	2,239	E 8
Florianópolis, Braz.	49,290	F 5
Florida, Uru.	16,000	E 6
Fordlandia, Braz.		E 3
Formosa, Arg.	16,506	E 5
Fortaleza (Ceará), Braz.	213,604	G 3
França, Braz.		F 4
French Guiana	26,854	E 2
Frio (cape), Braz.		F 5
Gaiba, Bol.		E 4
Gallinas (pt.), Col.		C 1
General Acha, Arg.	4,709	D 6
General Alvear, Arg.	2,548	D 6
Georgetown (cap.), Br. Guia.	73,509	E 2
Goiânia, Braz.	41,584	E 4
Goiás, Braz.	5,829	E 4
Gran Chaco (region)		D 5
Grande (bay), Arg.		D 8
Grande (riv.), Bol.		D 4
Grande (riv.), Braz.		F 5
Guajará-Mirim, Braz.	2,687	D 4
Guajira (pen.)		C 1
Guaporé (riv.)		D 4
Guasco (Huasco), Chile	1,537	C 5
Guaviare (riv.), Col.		C 2
Guayaquil, Ec.	258,966	B 3
Guayaquil (gulf), Ec.		B 3
Guiana, British	375,701	E 2
Guiana, French	26,854	E 2
Guiana Neth.(Surinam),	214,000	E 2
Gurupí (riv.), Braz.		F 3
Guyane, Fr. Guia.	21,997	E 2
Hanover (isl.), Chile		C 8
Hornos (Horn) (cape), Chile		D 8
Hoste (isl.), Chile		D 8
Huacas (pt.), Peru		C 4
Huacho, Peru	12,993	C 4
Huarás, Peru	11,054	C 3
Huascarán (mt.), Peru		C 3
Huasco (Guasco), Chile	1,537	C 5
Huila (mt.), Col.		C 2
Humaitá, Braz.	828	D 3
Iaco (riv.), Braz.		D 3
Ibagué, Col.	†100,000	C 2
Ibarra, Ec.	14,031	C 2
Ica, Peru	20,896	C 4
Içá (riv.), Braz.		D 3
Iguaçú (riv.)		E 5
Iguatu, Braz.	10,348	F 3
Ilhéus, Braz.	23,006	G 4
Illampu (mt.), Bol.		D 4
Ilo, Peru	1,043	C 4
Imeri (mts.)		D 2
Inini, Fr. Guia.	4,857	E 2
Iquique, Chile	39,576	C 5
Iquitos, Peru	31,828	C 3
Iriri (riv.), Braz.		E 3
Itaituba, Braz.	628	E 3
Ituxí (riv.), Braz.		D 3
Jachal, Arg.	4,278	D 6
Jaén, Peru	510	C 3
Jaguaribe (riv.), Braz.		G 3
Jamachim (riv.), Braz.		E 3
Jamundá (riv.), Braz.		E 3
Japurá (riv.), Braz.		D 3
Jarí (riv.), Braz.		E 3
Javarí (riv.)		C 3
Jiquié (Jequié),Braz.	21,322	F 4
João Pessoa (Paraíba), Braz.	90,853	G 3
Joinville, Braz.	21,102	E 5
Juan Fernández (isls.), Chile		C 6
Juázeiro, Braz.	16,465	G 3
Juiz de Fora, Braz.	86,819	F 5
Jujuy, Arg.	31,091	D 5
Juliaca, Peru	6,034	C 4
Juquiá, Braz.	899	F 5
Juruá (riv.), Braz.		D 3
Juruena (riv.), Braz.		E 4
Jutaí (riv.), Braz.		D 3
La Guaira, Ven.	16,279	D 1
La Paz (cap.), Bol.	321,073	D 4
La Plata, (Eva Perón), Arg.	207,031	E 6
La Plata (estuary)		E 6
La Quiaca, Arg.	6,768	D 5
La Rioja, Arg.	23,164	D 5
La Serena, Chile	37,618	C 5
Lábrea, Braz.	1,247	D 3
Laguna, Braz.	9,887	F 5
Las Plumas, Arg.		D 7
Leticia, Col.	1,674	D 3
Lima (cap.), Peru	628,821	C 4
Livramento, Braz.	29,906	E 6
Llanos del Orinoco (plain)		D 2
Llullaillaco (mt.)		D 5
Lobitos, Peru	4,168	B 3
Loja, Ec.	15,399	C 3
Lomas, Peru	500	C 4
Londrina, Braz.	33,707	E 5
Loreto, Col.		C 3
Los Vilos, Chile	1,305	C 6
Macapá, Braz.	10,094	E 2
Maceió, Braz.	102,301	G 3
Madeira (riv.), Braz.		D 3
Madre de Dios (isl.), Chile		C 8
Magallanes (Magellan) (str.), Chile		D 8
Magdalena (riv.), Col.		C 2
Maipu (mt.)		D 6
Malpelo (isl.), Col.		B 2
Mamoré (riv.), Bol.		D 4

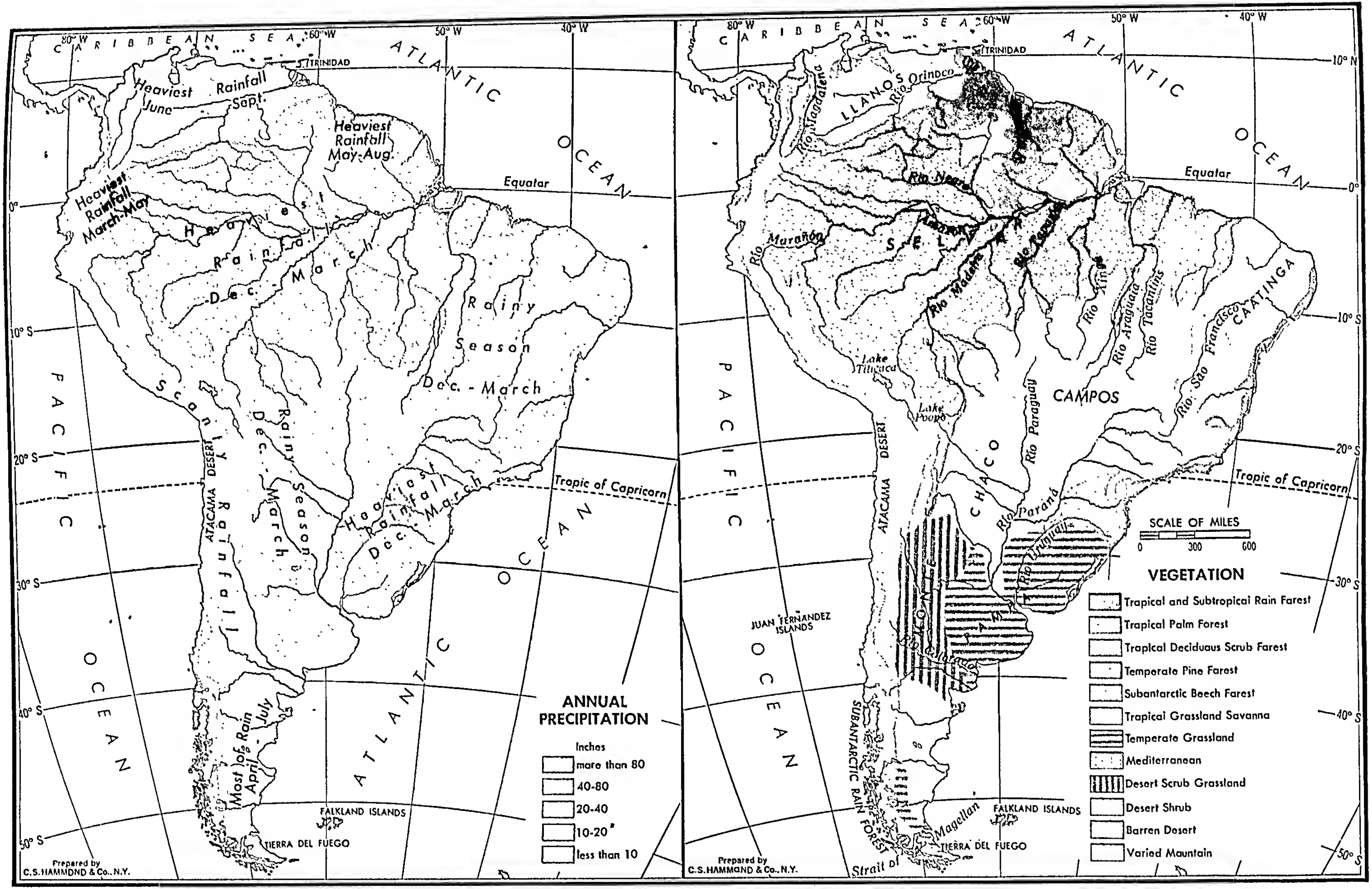
*All population figures are taken from the latest official census or estimate available. For date and source of a population figure, *see* article on the appropriate country.
†Includes suburbs.



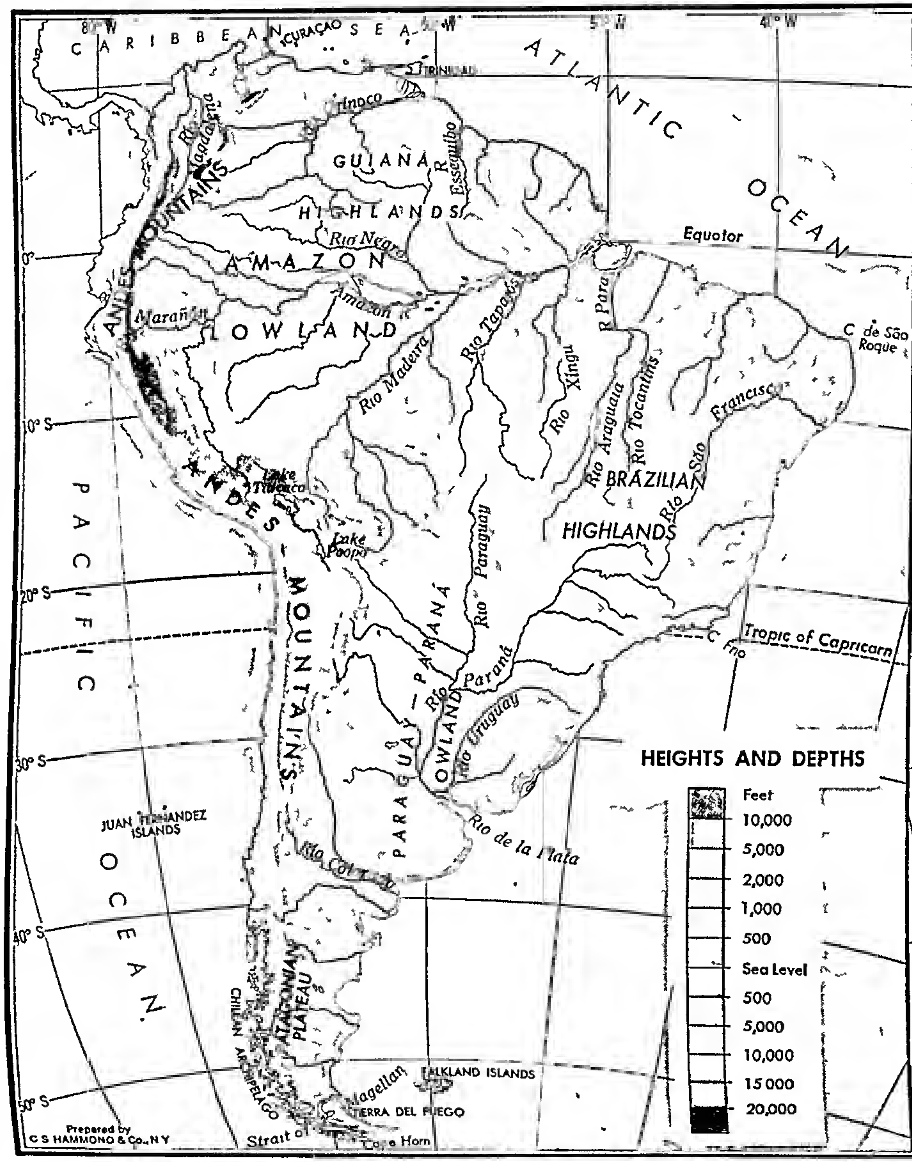
CARIBBEAN SEA
ATLANTIC OCEAN
PACI
Equator
PANAMA
CANAL ZONE (U.S.)
Colón
Cristobal
Panamá
G de Panamá
Golfo de Darién
Barranquilla
Cartagena
Sta Marta
Pta Gallinas
PEN DE GUAJIRA
Ciénaga
Mompós
Turbo
Medellín
C Corrientes
Buenaventura
I Malpelo (Col)
Bogotá
Tunja
Chiquinquirá
Bucaramanga
Cúcuta
Pamplona
Manizales
Ibagué
Tolima 18 438
Cali
Neiva
Huila 18 700
Popayán
Pasto
Tumaco
COLOMBIA
Magdalena
Cauca
Guaviare
Vichada
Meta
Arauca
Vaupés
Caquetá
Putumayo
Apaporis
Esmeraldas
Ibarra
Quito
Cotopaxi 19 498
Chimborazo 20 702
Manta
ECUADOR
Riobamba
Guayaquil
Golfo de Guayaquil
Cuenca
Loja
Napo
Tigre
Marañón
Lobitos
Paita
Piura
Pta de Aguja
Chiclayo
Pacasmayo
Trujillo
Chimbote
Huarás
Huascarán 22 180
Cajamarca
Jaén
Iquitos
Requena
PERU
Ucayali
Urubamba
Apurímac
Cerro de Pasco
Huacho
Callao
Lima
Oroya
Ayacucho
Pisco
Pta Huacas
Ica
Lomas
Arequipa
Matarani
Mollendo
Moquegua
Ilo
Tacna
Arica
Pisagua
Iquique
Cusco
Sta Ana
Juliaca
Puno
L Titicaca
La Paz
BOLIVIA
Oruro
Cochabamba
Sucre
Potosí
Santa Cruz
Trinidad
Riberalta
Guajará-Mirim
San Ignacio
Mamoré
Beni
Guaporé
Maracaibo
L de Maracaibo
G de Venezuela
Coro
Curaçao (Neth)
Willemstad
Bonaire (Neth)
Pto Cabello
La Guaira
Caracas
Valencia
Barquisimeto
Trujillo
Valera
Mérida
Barcelona
Cumaná
Carúpano
Margarita
VENEZUELA
ORINOCO
Orinoco
San Fernando
Ciudad Bolívar
Pto Carreño
Puerto Ayacucho
Caura
Sa Parima
Sa Pacaraima
St Lucia (Br)
St Vincent
Barbados (Br)
Bridgetown
Grenada (Br)
Tobago (Br)
TRINIDAD
Port of Spain
Morawhanna
BR. GUIANA
Georgetown
New Amsterdam
Cuyuni
Essequibo
Roraima 8 595
Rockstone
Nieuw Nickerie
Coronie
Paramaribo
SURINAM
Dam
Courantyne
Maroni
Mana
Sinnamary
I du Diable
Cayenne
GUYANE
FR. GUIANA
ININI
St Georges
Oyapock
Sa Acaraí
I de Maracá
Macapá
Canal do Norte
Caviana
Canal do Sul
Rio Pará
I de Marajó
Belém
Bragança
Gurupi
São Luís
Camocim
Parnaíba
Fortaleza (Ceará)
Aracatí
Areia Branca
Natal
C de São Roque
João Pessoa (Paraíba)
Recife (Pernambuco)
Maceió
Aracaju
Salvador (Bahia)
Ilhéus
Belmonte
Caravelas
Boa Vista
Rio Branco
São Felipe
Taracua
Barcelos
Moura
Manaus
Rio Negro
Japurá
Pto Córdoba
Içá
Loreto
Letícia
Tabatinga
Tefé
Amazonas
Juruá
Jutaí
Javari
Eirunepé
Xingu
Purus
Lábrea
Humaitá
Pôrto Velho
São Antônio
Madeira
Manicoré
Borba
Roosevelt
Aripuanã
Abunã
Villa Bella
Pto Maldonado
Parintins
Óbidos
Prainha
Santarém
Belterra
Itaituba
Fordlandia
Tapajós
Bacabal
Jamachim
Iriri
São Manuel
Juruena
Arinos
Diamantino
Mato Grosso
Planalto de Mato Grosso
Cuiabá
Corumbá
Pôrto Esperança
Campo Grande
Alcobaça
Cametá
Marabá
Araguaia
Conceição do Araguaia
Roncador
I do Bananal
Serra do Estrondo
Tocantins
Tocantinópolis
Carolina
Sa da Desordem
Codó
Caxias
Teresina
Crateús
Iguatu
Cajazeiras
Juàzeiro do Norte
Paulistana
Petrolina
Juàzeiro
Remanso
Alto Parnaíba
Pôrto Nacional
Paranã
Palma
Goiás
Goiânia
Anápolis
FUTURO DISTRITO FEDERAL
Carinhanha
Pirapora
Montes Claros
Minas Novas
Diamantina
Belo Horizonte
São Francisco
Jequié
Brumado
Cachoeira
França
Senhor do Bonfim
Propriá
Alagoinhas
Sertânia
BRAZIL
CAMPOS


SOUTH AMERICA
LAMBERT AZIMUTHAL EQUAL-AREA PROJECTION
SCALE OF MILES
0 100 200 400 600
SCALE OF KILOMETRES
0 100 200 400 600
Capitals of Countries
International Boundaries
Canals
Railroads
Copyright by C.S. HAMMOND & CO., N.Y.
7590
Longitude 60° West of Greenwich
Tropic of Capricorn
PACIFIC OCEAN
ATLANTIC OCEAN
FALKLAND ISLANDS (Br.)
West Falkland
East Falkland
Port Stanley
URUGUAY
BUENOS AIRES
Montevideo
Asunción
Santiago
Valparaíso
RIO DE JANEIRO
São Paulo
Córdoba
Rosario
Tierra del Fuego
Cabo de Hornos (Cape Horn)
I. de los Estados (Staten I.)
ARCHIPIÉLAGO de los CHONOS
Isla de Chiloé
Is. Juan Fernández (Chile)
I. de San Félix (Chile)
I. San Ambrosio (Chile)
Río de la Plata
Estrecho de Magallanes

Mana, Fr. Guia.	1,443	E 2
Manaus, Braz.	110,678	E 3
Manicoré, Braz.	2,241	D 3
Manizales, Col.	†134,000	C 2
Manta, Ec.	19,028	B 3
Mapuera (riv.), Braz.		E 3
Mar (mts.), Braz.		F 5
Mar del Plata, Arg.	114,729	E 6
Marabá, Braz.	4,937	E 3
Maracá (isl.), Braz.		F 2
Maracaibo, Ven.	232,488	C 1
Maracaibo (lake), Ven.		C 1
Marajó (isl.), Braz.		F 3
Marañón (riv.), Peru		C 3
Margarita (isl.), Ven.		D 1
Mariscal Estigarribia, Para.	8,756	D 5
Maroni (riv.)		E 2
Más Afuera (isl.), Chile		B 6
Más a Tierra (isl.), Chile		C 6
Matarani, Peru		C 4
Mato Grosso, Braz.	427	E 4
Mato Grosso (plateau) Braz.		E 4
Medellín, Col.	355,000	C 2
Melo, Uru.	23,000	E 6
Mendoza, Arg.	97,496	D 6
Mercedario (mt.)		C 6
Mercedes, Arg.	30,575	D 6
Mercedes, Uru.	35,000	E 6
Mérida, Ven.	24,994	C 2
Meta (riv.)		D 2
Minas Novas, Braz.	1,269	F 4
Mirim (lake)		E 6
Misti (mt.), Peru		C 4
Mollendo, Peru	12,259	C 4
Mompos, Col.	6,900	C 2
Montes Claros, Braz.	20,795	F 4
Montevideo (cap.), Uru.	850,000	E 6
Moquegua, Peru	3,718	C 4
Morawhanna, Br. Guia.	305	E 2
Mortes (riv.), Braz.		E 4
Moura, Braz.		D 3
Napo (riv.)		C 3
Nassau (gulf), Chile		D 8
Natal, Braz.	97,736	G 3
Negro (riv.), Braz.		D 3
Negro (riv.), Arg.		D 6
Neiva, Col.	40,818	C 2
Netherlands West Indies	154,914	D 1
Neuquén, Arg.	7,498	D 6
New Amsterdam, Br. Guia.	9,567	E 2
Nieuw Nickerie, Sur.	3,141	E 2
Niterói, Braz.	174,535	F 5
Norquincó, Arg.		D 7
Norte (channel), Braz.		F 2
Óbidos, Braz.	3,487	E 3
Ollagüe (Oyahue), Chile		D 5
Orán, Arg.	6,706	D 5
Orinoco (riv.)		D 2
Oroya, Peru		C 4
Oruro, Bol.	62,975	D 4
Ouro Prêto, Braz.	9,247	F 5
Ovalle, Chile	17,573	C 6
Oyahue (Ollagüe), Chile		D 5
Oyapock (riv.)		E 2
Pacaraima (mts.)		D 2
Pacasmayo, Peru	6,615	B 3
Paita, Peru	6,797	B 3
Palma (riv.), Braz.		F 4
Pampas (plain), Arg.		D 6
Pamplona, Col.	17,000	C 2
Pará (estuary), Braz.		F 2
Pará (Belém), Braz.	230,181	F 3
Paraguay	1,251,517	E 5
Paraguay (riv.)		E 4
Paraíba (João Pessoa), Braz.	90,853	G 3
Paramaribo (cap.), Sur.	67,381	E 2
Paraná, Braz.	594	F 4
Paraná, Arg.	84,153	E 6
Paraná (riv.), Braz.		F 4
Paraná (riv.)		E 5
Paranaguá, Braz.	16,046	F 5
Paranaíba (riv.), Braz.		F 4
Pardo (riv.), Braz.		F 4
Parecis (mts.), Braz.		D 4
Paria (gulf)		D 1
Parima (mts.)		D 2
Parintins, Braz.	5,943	E 3
Parnaíba, Braz.	30,900	F 3
Parnaíba (riv.), Braz.		F 3
Pasto, Col.	†81,000	C 2
Patagonia (region), Arg.		D 7
Patos (lake), Braz.		F 6
Paulistana, Braz.	1,042	F 3
Paysandú, Uru.	46,000	E 6
Pelotas, Braz.	79,649	E 6
Peñas (gulf), Chile		C 7
Pergamino, Arg.	32,382	D 6
Pernambuco (Recife), Braz.	522,466	G 3
Peru	8,240,000	C 4
Petrolina, Braz.	7,439	F 3
Petrópolis, Braz.	61,843	F 5
Pilcomayo (riv.)		D 5
Pirapora, Braz.	9,012	F 4
Pisagua, Chile	241	C 4
Pisco, Peru	14,240	C 4
Piura, Peru	19,027	B 3
Poopó (lake), Bol.		D 4
Popayán, Col.	†45,000	C 2
Port Stanley (cap.), Falk. Is.	1,252	E 8
Pôrto Alegre, Braz.	381,964	E 5
Pôrto Esperança, Braz.		E 4
Pôrto Mendes, Braz.		E 5
Pôrto Nacional, Braz.	2,953	F 4
Pôrto Tibiriça, Braz.		E 5
Pôrto Velho, Braz.	10,205	D 3
Posadas, Arg.	37,588	E 5
Potosí, Bol.	45,758	D 4
Prainha, Braz.	245	E 3
Propriá, Braz.	12,962	G 4
Puerto Ayacucho, Ven.	2,928	D 2
Puerto Cabello, Ven.	34,413	D 1
Puerto Carreño, Col.		D 2
Puerto Casado, Para.	6,269	E 1
Puerto Córdoba, Col.		D 3
Puerto Deseado, Arg.	3,392	D 7
Puerto Madryn, Arg.	3,441	D 7
Puerto Maldonado, Peru	1,032	C 4
Puerto Montt, Chile	28,944	C 7
Puerto Natales, Chile	8,140	C 8
Puerto Santa Cruz, Arg.		D 8
Puerto Suárez, Bol.	1,159	E 4
Puno, Peru	13,786	C 4
Punta Arenas, Chile	34,440	D 8
Purús (riv.), Braz.		D 3
Putumayo (riv.)		C 3
Quequén, Arg.		E 6
Quito (cap.), Ec.	209,932	C 3
Rawson, Arg.		D 7
Recife (Pernambuco), Braz.	522,466	G 3
Reconquista, Arg.	12,729	D 5
Remanso, Braz.	4,464	F 3
Requeña, Peru		C 3
Resistencia, Arg.	52,385	D 5
Ribeirão Prêto, Braz.	65,081	F 5
Riberalta, Bol.	6,549	D 4
Rio Branco, Braz.	9,592	D 3
Río Cuarto, Arg.	48,706	D 6
Rio de Janeiro (cap.), Braz.	2,335,931	F 5
Río Gallegos, Arg.	5,880	D 8
Rio Grande, Braz.	*64,241*	*E 6*
Río Mulato, Bol.	378	D 4
Riobamba, Ec.	29,830	C 3
Rivera, Uru.	30,000	E 6
Rocha, Uru.	25,000	E 6
Rockstone, Br. Guia.		E 2
Roncador (mts.), Braz.		E 4
Roosevelt (riv.), Braz.		D 3
Roraima (mt.)		D 2
Rosario, Arg.	4,927	D 5
Rosario, Arg.	467,937	D 6
Saint Georges, Fr. Guia.		E 2
Sajama (mt.)		D 4
Saladillo (riv.), Arg.		D 5
Salado (riv.), Arg.		D 5
Salado (riv.), Arg.		D 6
Salina Grande, Arg.		D 7
Salta, Arg.	67,403	D 5
Salto, Uru.	44,000	E 6
Salvador (Bahia), Braz.	395,993	G 4
San Ambrosio (isl.), Chile		C 5
San Antonio, Arg.		D 5
San Antonio (cape), Arg.		E 6
San Carlos de Bariloche, Arg.	6,562	D 7
San Diego (cape), Arg.		D 8
San Félix (isl.), Chile		B 5
San Fernando, Ven.	13,377	D 2
San Ignacio, Bol.	1,757	D 4
San Jorge (gulf), Arg.		D 7
San Juan, Arg.	82,410	D 6
San Julián, Arg.	3,050	D 7
San Luis, Arg.	25,147	D 6
San Martín (lake)		C 7
San Matías (gulf), Arg.		D 7
San Rafael, Arg.	28,847	D 6
Santa Ana, Bol.		D 4
Santa Ana, Peru		C 4
Santa Catarina (isl.), Braz.		F 5
Santa Cruz., Bol.	42,746	D 4
Santa Fé, Arg.	168,791	D 6
Santa Inés (isl.), Chile		C 8
Santa Marta, Col.	†50,000	C 1
Santa Rosa, Arg.	14,623	D 6
Santarém, Braz.	14,604	E 3
Santiago del Estero, Arg.	60,039	D 5
Santiago (cap.), Chile	1,348,283	D 6
Santos, Braz.	201,739	F 5
São Antônio, Braz.		*D 3*
São Felipe, Braz.		D 2
São Francisco (riv.), Braz.		F 4
São João da Boa Vista, Braz.	16,417	F 5
São Luís, Braz.	81,432	F 3
São Manuel (riv.), Braz.		E 3
São Paulo, Braz.	2,041,716	F 5
São Roque (cape), Braz.		G 3
São Sebastião (isl.), Braz.		F 5
São Tomé (cape), Braz.		G 5
Selvas (forest), Braz.		D 3
Senhor do Bonfim, Braz.	10,305	G 4
Sinnamary, Fr. Guia.	1,373	E 2
Sorocaba, Braz.	69,631	F 5
Staten (Estados) (isl.), Arg.		D 8
Sucre (cap.), Bol.	40,128	D 4
Sul (channel), Braz.		F 2
Surinam	214,000	E 2
Tabatinga, Braz.		D 3
Tacna, Peru	11,025	C 4
Taitao (pen.), Chile		C 7
Talca, Chile	55,059	C 6
Talcahuano, Chile	54,780	C 6
Taltal, Chile	4,901	C 5
Tandil, Arg.	32,309	D 6
Tapajós (riv.), Braz.		E 3
Taracuá, Braz.		D 3
Tarija, Bol.	16,869	D 5
Tefé, Braz.	2,220	D 3
Temuco, Chile	51,497	C 6
Teresina, Braz.	53,425	F 3
Tierra del Fuego (isl.)		D 8
Tietê (riv.), Braz.		E 5
Tigre (riv.), Peru		C 3
Tinogasta, Arg.	2,169	D 5
Titicaca (lake)		D 4
Tocantinópolis, Braz.	3,736	F 3
Tocantins (riv.), Braz.		F 4
Tocopilla, Chile	19,353	C 5
Tolima (mt.), Col.		C 2
Tres Montes (cape), Chile		C 7
Tres Puntas (cape), Arg.		D 7
Trinidad, Bol.	8,695	D 4
Trujillo, Peru	36,958	B 3
Trujillo, Ven.	11,794	D 2
Tucumán, Arg.	194,166	D 5
Tumaco, Col.	10,500	C 2
Tunja, Col.	†30,900	C 2
Tupiza, Bol.	*8,248*	*D 5*
Turbo, Col.		C 2
Uberaba, Braz.	43,915	F 4
Ucayali (riv.), Peru		C 3
Urubamba (riv.), Peru		C 4
Uruguaiana, Braz.	33,272	E 5
Uruguay	2,353,000	E 6
Uruguay (riv.)		E 5
Ushuaia, Arg.		D 8
Uyuni, Bol.	6,968	D 5
Valdés (pen.), Arg.		D 7
Valdivia, Chile	45,138	C 6
Valencia, Ven.	88,674	D 2
Valera, Ven.	20,888	C 2
Vallenar, Chile	9,677	C 5
Valparaíso, Chile	218,829	C 6
Vaupés (riv.), Col.		C 2
Venezuela	4,985,716	D 2
Venezuela (gulf), Ven.		C 1
Vichada (riv.), Col.		D 2
Victorica, Arg.	2,475	D 6
Viedma, Arg.	4,683	D 7
Viedma (lake), Arg.		C 7
Vilconota (mt.), Peru		C 4
Villa Bella, Bol.	88	D 4
Villa María, Arg.	30,362	D 6
Villa Montes, Bol.	3,105	D 5
Villarrica, Chile	4,679	C 6
Villarrica, Para.	27,532	E 5
Viña del Mar, Chile	85,281	C 6
Vitória, Braz.	51,329	G 5
Wellington (isl.), Chile		C 7
West Falkland (isl.), Falk. Is.		D 8
Xingú, Braz.		D 3
Xingú (riv.), Braz.		E 3
Yacuiba, Bol.	5,027	D 5
Zapala, Arg.	3,387	D 6

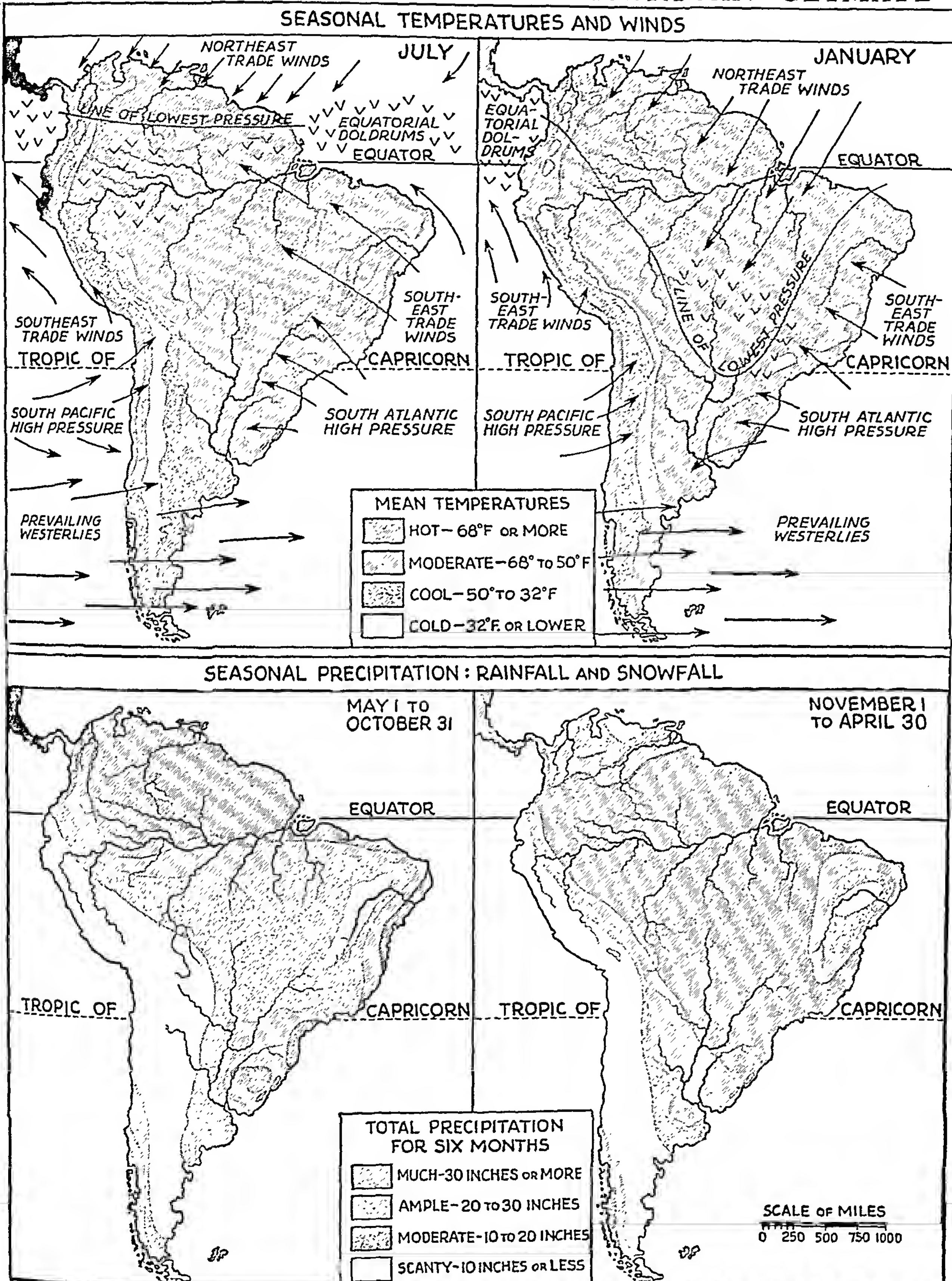


Comparison of these maps reveals sharp contrasts between the east and west coasts of South America. The heavy rainfall and denso rain forest of the Amazon basin stop abruptly at tho Andes Mountains (light blue area on map at right). Most of the west coast is dry. The grassy pampas in the southeast support vast herds of stock.



These maps show that South America's heaviest population is concentrated around the rim of the continent Here lie the larger cities which serve as market centers for the varied produce of the land Notice that the rugged Andes highlands, in the west, have a greater population than the steaming tropical lowland

CHIEF FEATURES OF SOUTH AMERICAN CLIMATE

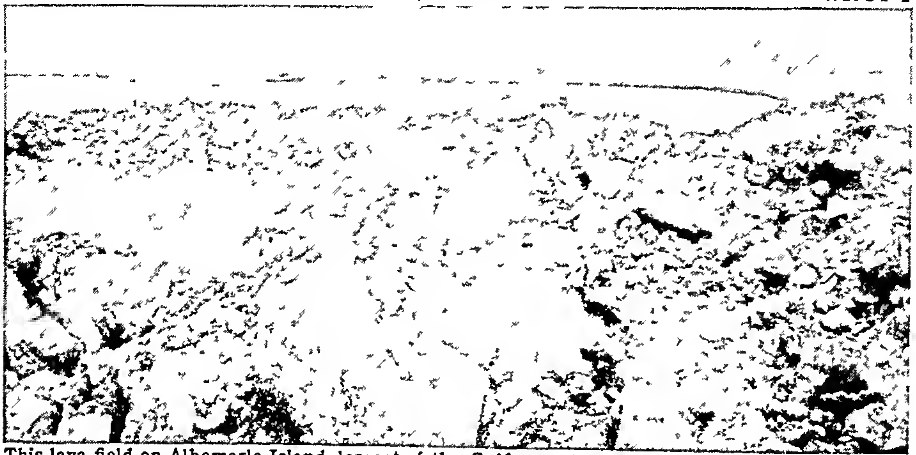


The upper maps show how climate is determined, first of all, by seasonal changes in the overhead position of the sun. When the sun is in the north in July, the greatest heat and lowest atmospheric pressure occur near the north coast (upper left). In January, these conditions prevail near the Tropic of Capricorn (upper right). The prevailing winds shift with the sun, and rainfall follows them (lower maps). Notice, however, that in the west no great changes occur. There the tempering influence of the Pacific Ocean and the towering Andes Mountains keep the climate much the same all year, with only slight north-south shifts.

de la Plata (Plata River). Ninety per cent of the continent drains to the Atlantic.

The character of the coasts is fixed most of all by the fact that South America in general has been tilting slightly, century by century, upward in the north and downward in the south. Along the north half of the Pacific coast this steady rising has brought the mountains up sharply from sea level, leaving a straight and almost harborless coast line. A further reason for the lack of harbors is the fact that along most of this coast very little rain falls. Hence there are no strong river currents to cut valleys down to sea level and thus form bays.

IN THE REMOTE GALÁPAGOS, WHERE VOLCANOES STILL ERUPT



This lava field on Albemarle Island, largest of the Galápagos Islands, was formed by the eruption of 1925. The group, which contains 12 main islands, lies on the Equator about 600 miles west of Ecuador, to which it belongs. It is famous for its giant lizards and tortoises.

Vessels must lie in open water and send passengers and cargo ashore in small boats called *lighters*, except where breakwaters and piers have been built into the open ocean. The only exception is at Guayaquil up the Guayas River in Ecuador. But even this fine natural harbor is sometimes blocked by river silt.

Similarly along the Caribbean coast and the northern half of the Atlantic coast, the land presents an all but unbroken front to the sea for more than 2,000 miles. The only breaks are the mouths of large rivers, and a few bays.

In the south, where the land is sinking, these conditions are reversed. The gently sloping Atlantic coast is scalloped with shallow bays where the sea is invading the lower portions. On the mountainous Pacific coast, the narrow Chilean valleys have become fiords and sounds. Valparaiso, Chile's chief seaport, is on a deep bay. In the far south, the mountains of the Coastal Range have sunk until their tops now are islands—the Chilean Archipelago.

Islands of South America

At the extreme south the sea has cut completely across the continent in the Strait of Magellan, making the tip a great archipelago, Tierra del Fuego.

Aside from these southern groups, South America has few islands. Off the northern coast, the peaks of submerged mountains appear above the ocean level as Trinidad and the Curaçao group. On the Pacific side the only considerable islands are the Galápagos (Archipelago de Colón) on the Equator west of Ecuador, and the Juan Fernandez Islands of Chile west of Valparaiso. In the southern Atlantic, 300 miles east of the Strait of Magellan, are the Falkland Islands. Like Tierra del Fuego, these islands were once a part of the South American mainland.

General Character of the Climate

The North American finds types of climate very different from his own on a tour of the continent. Three-fourths of South America is within the tropics. This part of the continent is hot the year round, with a tremendous rainfall, except where the mountains rise to cooler regions. Near the Equator one may climb in a few hours from intense heat to almost Arctic cold. But whatever the prevailing temperature may be at the various levels in these tropical regions, it varies little from season to season. "Summer" and "winter" are much alike, except in the amount of rainfall.

Farther south, in the middle latitudes of Argentina and Chile, there are climates more like those of the United States and Canada. But here the continent is so narrow that temperature is modified by the nearness of the oceans. Nowhere does one find a continental climate with great differences between summer and winter. Even in northwestern Argentina, where the difference is greatest, it is only about 30°. In general, too, the difference between day and night temperatures is far less than it is in the northern part of America. Thus in most parts of the southern continent, one misses the invigorating effects of a changeable climate with great differences between day and night, summer and winter.

Since most of South America lies south of the Equator, the seasons are opposite to those of North America. When the Northern Hemisphere shivers in the grip of winter, the sun is near the Tropic of Capricorn in the Southern Hemisphere, and most of South America has summer. When summer comes to the Northern Hemisphere, the sun is near the Tropic of Cancer and most of South America has its winter. Our poetic line, "What is so rare as a day in June," about fine summer weather would seem all wrong in Argentina or Chile. There the line should read, "What is so rare as a day in December."

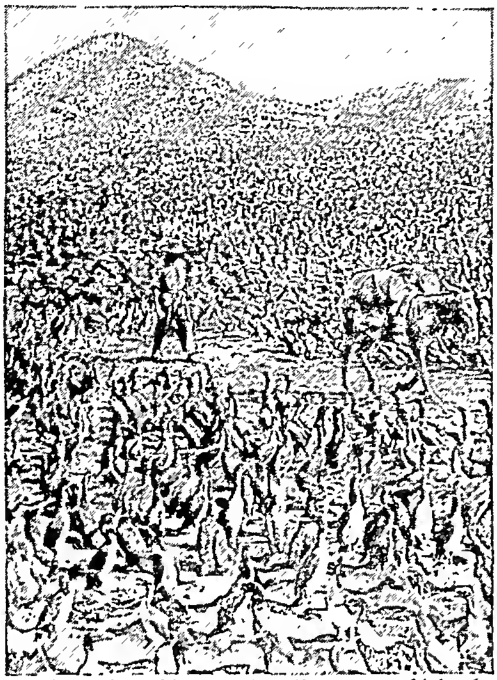
Great Variety of South American Climates

Because of its extent through 63° of latitude, and because of the mountains and ocean currents,

South America has many climates. They range from the perpetual heat and rain of the equatorial forests to the hot arid plains of western Argentina and the Arctic cold of the high Andes. Between these extremes are the mild and pleasant climates of Chile's Central Valley, Argentina's Pampa, and Brazil's coffee-growing highlands.

These climates fall into four great belts: (1) the region of equatorial heat and heavy rainfall across the broadest part of the continent; (2) and (3) the belts of trade winds to the north and south of the equatorial region; (4) the belt of westerly winds in the middle latitudes of the south (*see* Climate; Weather; Winds).

TROPICAL ISLAND OFF PERU



Myriads of sea birds nest on the scores of islands that fringe the coast of Peru. Their guano was once Peru's chief source of wealth.

But temperature and precipitation do not depend solely on distance from the Equator and situation with respect to prevailing winds. Another important climate-making factor in South America is the tremendous barrier of the Andes.

Effect of Mountains and Highlands

In ascending these mountains, one finds constantly decreasing temperatures. In tropical latitudes, for every 300 feet of elevation there is usually a drop of about one degree of temperature. People often suffer from cold in Quito, which is almost on the Equator but at a height of about 9,000 feet. So abrupt are the changes of climate at various levels that in La Paz one household servant may be sent in the morning to the heights above for a load of ice and another to lower levels for tropical fruits, both returning at noon with their contrasting burdens.

Similar variations in temperature are produced by the Guiana and Brazilian highlands in the east of the continent. In the south central part of the Brazilian Highlands, where the elevation is between 2,000 and 4,000 feet, temperatures average seven or eight degrees lower the year round than they do at sea level in the same latitudes.

The mountains and highlands also largely determine where rain will fall, and how much. Over the tropical part of the continent east of the Andes, much of the supply of moisture is brought from the Caribbean Sea and the Atlantic by the trade winds from the northeast and the southeast. These winds discharge most of their moisture as they climb the slopes of the Guiana and the Brazilian highlands. Nearly all the rest of their moisture is precipitated upon the basin of the Amazon and on the eastern slope of the Andes. Only a small amount reaches the summits of the mountains, where it falls as snow. All the continent west of the mountain crests is, in general, cut off from the Atlantic winds. This is one of the reasons why most of the tropical portion of the Pacific Coast gets no rain, except for light drizzles from fogs and rare downpours every few years. The only wet part of this coast is in the north, where tropical showers bring heavy rainfall every month and almost every day.

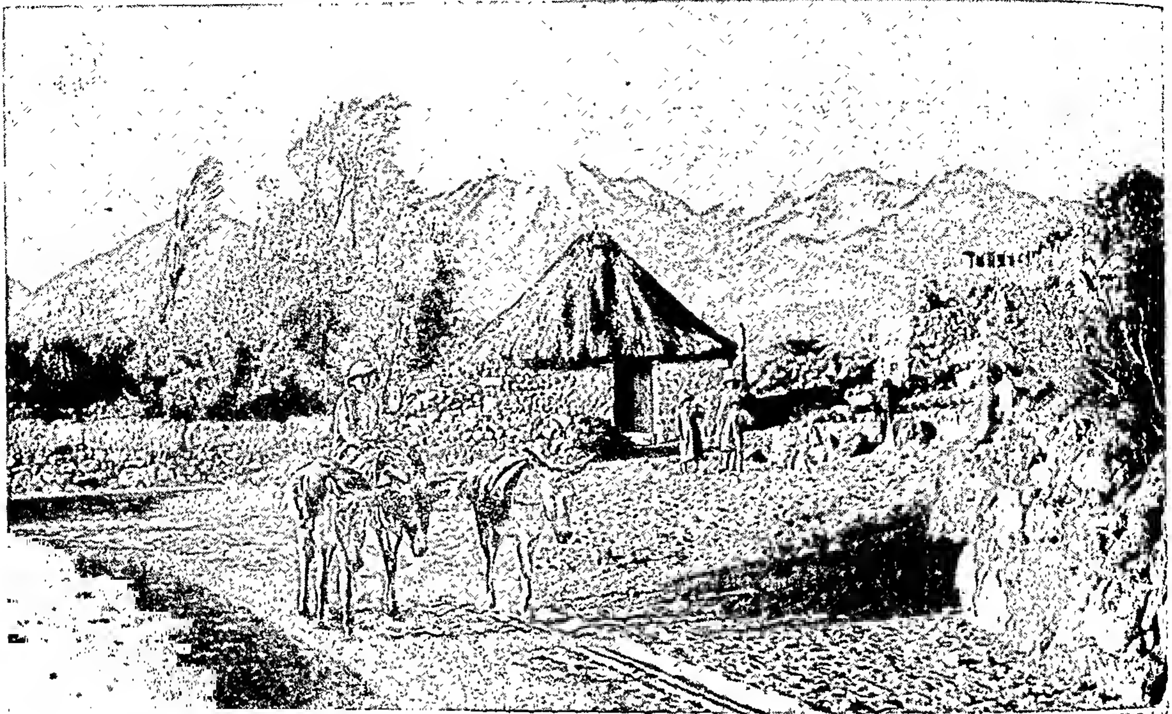
In the middle latitudes to the south, this east-west arrangement of wet and dry regions is reversed. Here the moisture-bearing winds come from the Pacific, and they drop almost all of their moisture on the western slopes of the Andes. Southern Argentina would be a desert if these winds, after passing over the mountains, did not set up cyclonic storms which draw in some moisture from the South Atlantic.

Wet and Dry Seasons

In the tropics the entire system of winds and rainfall shifts north and south with the seasons. The maps on page 257 show this clearly. In the South

PRIMITIVE PEOPLE IN TIERRA DEL FUEGO

Trees and people have a hard time of it in the chilly winds that constantly roar over Tierra del Fuego. These Ona Indians are among the world's most primitive people. Their scanty clothing consists chiefly of guanaco furs, and for shelter they build only windbreaks of guanaco hides.



The Indian farmer of the cool Peruvian uplands (top picture) has built a snug, permanent home of stone with a thatched roof. He sets off to market with donkeys to carry him and his load. The hunting folk (bottom picture) of the steaming Amazon basin build a new hut often whenever they move in search of game or a fresh garden clearing. They stick tree branches into the ground for the airy walls and make a steep, thatched roof to shed the heavy rains. Many Amazon people wear little clothing; but this tribe uses long, dark garments to keep out the heat.

American summer months from December to March, the belt of tropical rain reaches into southern Brazil, and as far north as the Guiana Highlands. In winter the southern edge of tropical rain shifts north to the Amazon River, and the northern edge is off the continent and over the Caribbean Sea.

The trade winds shift similarly in summer and winter. Hence the difference between wet and dry seasons in the trade-wind belts depends upon whether they are getting trade-wind rainfall or tropical thundershowers. Precipitation conditions in the middle latitudes also shift somewhat with the seasons.

Ocean currents also influence the climate of certain regions. The most important of these is the Humboldt Current from the Antarctic, which cools the west coast from about 40° south latitude almost to the Equator. The on-shore winds that pass over this current are cooled, and thus become drying winds as they blow over the warm land. This helps to make most of this region almost rainless.

How Climate Influences Human Life

The character of the climate has profoundly influenced human life in the various regions. It is the republics of the middle latitudes—Argentina, Chile, Uruguay—and parts of Brazil where height moderates the tropical heat, that are the most progressive, the most productive, and the wealthiest. It is these republics too that have the largest proportion of whites and have attracted the greatest number of immigrants from European countries in the last half century. In the vast tropical lowland areas, white men find it hard to live and work; and here many of the people are Indian tribes living much as their ancestors did centuries ago.

Most of the people live on the rim of the continent, near the sea, as is shown by the maps on a later page. In the tropical regions of the northwest and the Caribbean countries they live in the cooler interior highlands. Only on the temperate Pampa of Argentina is there any considerable concentration of population at low altitudes.

The great cities too are on or near the coast. Many of these are in pairs: a large city in the higher interior where the temperature is agreeable, with its seaport below on the hot seacoast. Examples are Carácas and La Guaira in Venezuela; Guayaquil and Quito in Ecuador; Valparaiso and Santiago in Chile; Santos and São Paulo in Brazil.

The Pattern of Human Life and Activities

The Indians of South America, it is generally believed, came from North America at some time after the end of the last Ice Age. But they differ in their languages and in many other ways from those that remained north of the Rio Grande. This indicates that the two groups have been separated for a long time. On the basis of culture, or ways of living, the South American Indians can be divided into the tropical forest Indians, the hunting Indians of the plains and the cool forests, the primitive fisherfolk of the far south, and the advanced mountain or highland Indians of the Andes.

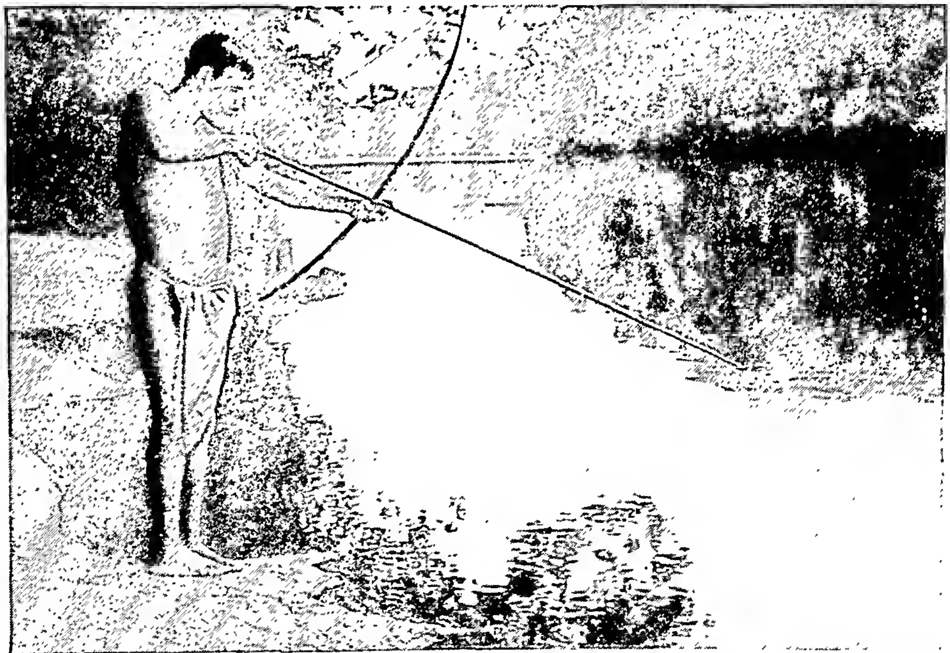
Indians of the Tropical Forest

In the forests of the Amazon, the Orinoco, and the northern coast, the Indians build houses along the rivers on the highest land they can find, to be above flood water in the rainy season. They set poles in the ground to support a floor, with two tall poles to hold a ridgepole for the roof. From the ridgepole they hang thatch made of long jungle grass or shredded palm leaves.

The family sleeps in hammocks made of palm-bark fiber. Hunting weapons hang from the roof. On the floor are pots and other utensils for preparing food, and simple implements for weaving cloth. For cutting tools, in the days before white men brought iron axes and knives, the Indians used stone axes which they got by trade with other regions. They made knives of ironwood, and for drilling and scraping implements they set the teeth of animals in wooden handles.

Men and women usually wear only a piece of fiber cloth wrapped about the waist, and perhaps a band around the hair. Children wear nothing. In this hot

WHERE INDIANS FISH WITH BOW AND ARROW



Natives of the Amazon region shoot fish instead of catching them with hook and line. Some also use long blowpipes from which they shoot poison darts. Their only garment is a bit of fiber cloth tied about the waist.

climate, clothing is more important to hold ornaments and magic charms than it is as covering.

For food, the men harpoon or shoot fish, snare turtles, and hunt other game. From turtle eggs they extract a cooking oil. They place the eggs in a hollow log and tread them into a jelly with their feet; then water is added, and the oil which floats to the surface is skimmed off. Some tribes use the bow and arrow for hunting. Others use a blowpipe, from 10 to 12 feet long. With this they shoot long, thin darts like hatpins, poisoned with curare or with juice from the assaca.

Many tribes practise a primitive agriculture. The men prepare a little clearing by girdling and burning the trees. Then the women grow yams, corn, and cassava (manioc). The roots of the bitter cassava contain a poison. To remove it, the women cut up the roots and place the pieces in a tubelike basket. Stretching and twisting the basket presses out most of the poisonous juice. Washing and roasting destroys the rest. The product is a mealy flour, which is baked into bread and used in preparing other dishes (*see* Tapioca).

INDIANS OF THE PERUVIAN HIGHLANDS

It's All-Saints' Day, and this Indian family is off to the festival in the town. The man in the center is holding a home-made harp, which he will strum as the others dance

Instead of scalping enemies, as many North American Indians did, some forest tribes in South America cut off the heads and preserved them by drying. The Jivaros, on the lower slopes of the Andes in Ecuador, developed marvelous skill in this. They removed the bone, and then filled the skin with hot pebbles, pressing it carefully to keep the shape while it dried and shrank to the size of a man's fist.

In spite of the easy life and abundant food, the number of forest Indians is small. Some authorities think that the entire Amazon basin contains no more than 100,000 of them. At the time when the white men came the most widespread group was the Tupi. A branch of these folk, the Guarani, was spreading to the south. Mixed with Spanish blood, the Guaranis now make up nearly all the population of Paraguay. The Arawaks and Caribs were powerful on the north coast. The Caribs, now virtually extinct, also peopled the islands of the Caribbean Sea, which got its name from them. (*See also* Amazon River; Brazil.)

Hunting Indians of the South

On the grassy Pampa of Argentina, the Indians lived by hunting, much as did the tribes on the western plains of North America. Since they had to follow their game, they built nothing more than windbreaks of hides or brush for shelter. For food they hunted the guanaco (wild llama) with bow and arrow, and the rhea with a *bola*, made of two or more thongs of rawhide knotted together at one end and weighted at the free ends with stones. The hunter threw this missile around the neck or legs of the bird to bring it down, and then dispatched it with a spear.

Only a few remnants of these Pampa Indians still live in outlying districts. They seem to have been a mixture of the Guaranis from the forests farther north, and the hunting Araucanians from the cool forests of what is now southern Chile. The Araucanians call themselves *Mapuches*, or "men of war." They managed to keep the Spaniards out of their territory, and little is known of their early life, except that they lived by hunting and fishing. Today they also raise animals and grow crops. They live in thatched huts with earth floors covered with sheepskin. Both men and women wear bright-colored blankets.

The men also wear a *poncho*, a large, blanketlike square of cloth with a hole in the center for the head. The women go barefooted, bare-armed, and bareheaded, with their hair in two braids held by a band of colored cloth or silver rings. The Araucanians once numbered about half a million, but alcohol and disease have reduced them to a tenth of this. (*See also* Chile.)

Primitive Fisherfolk of Tierra del Fuego

When white men first explored the Strait of Magellan and near-by islands, they found Yahgan and Ona Indians. These people lived in the most primitive fashion. They killed guanaco, when they could, with slings and spears; but the common foods were fish, shellfish, berries, and fungi. For shelter in this

cold region they had mere windbreaks of leaves and bark, covered in winter with guanaco hides. Their only garment was a sealskin or the fur of a guanaco, worn on the shoulder toward the wind. They fished in bark canoes, which always carried a fire built on sod in the middle. They made knives and hammers of stone, and used a whalebone tool to pry bark from trees. These Fuegian tribes have all but disappeared.

On the mainland north of the Strait of Magellan, the Patagonians lived almost as rudely; but, in spite of their hard life, they were among the tallest of men. Their name, given by Magellan, means "big feet." Few of them survive.

Highland Indians

In contrast to these primitive folk stood the advanced Indians whom the white men found living over most of the Andean highlands. Chief of these were the Incas of Peru. In many ways these people were as highly civilized as the Egyptians and the Sumerians of Mesopotamia at the dawn of history. Although they had invented neither writing nor the wheel, in government and many arts and crafts they were fully equal to the founders of civilization in the Old World. They made tools and rich ornaments of copper, bronze, silver, and gold. They spun thread as fine as the best made today, and wove it into rich fabrics. In the highlands they used llama wool; on the lower coastal lands of Peru the favorite material was cotton. They made splendid headdresses of feathers, and they made fine pottery.

The most impressive work of the Incas, however, was in building with stone. They enlarged their fields on the steep hillsides by building stone terraces filled with soil. Stone aqueducts carried water over valleys for irrigation and to supply towns. Stone roads and bridges connected the cities, with post houses and trained runners every few miles to carry government messages.

One of the many remarkable structures which still stand is the Great Wall of Peru, a chain of forts connected by a wall, running inland from near Chimbote in northern Peru. It is illustrated later in the article. Like China's Great Wall, it was built to check invaders; but nobody knows whether a neighboring tribe built it to keep out the conquering Incas or the Incas built it to hold one of their frontiers. Another amazing ruin is a town built of stone at Machu Picchu, near Cuzco in Peru. Here are the remains of a huge temple, a convent for Inca priestesses, palaces, and a tower which may have been a tomb. The town was a maze of narrow streets and stone stairs; fountains abounded. Today we can only guess how these Indians achieved such high development, since they left no written records to tell us. We know, however, that the absence of trees made cultivation easy, and mountain snow made irrigation possible. They had plenty of easily worked copper and tin. From this they could make bronze tools for working the abundant stone.

WHERE ONCE STOOD A GREAT INCA CITY

The vast ancient city of Machu Picchu was forgotten for centuries until its ruins were discovered in 1911.

The Incas, who spoke the Quichua (or Quechua) language, held under their rule a more numerous people, the Aymarás. Their domain extended north into Ecuador. In Colombia lived the Chibchas. These people did not build with stone, and the relics they left do not show so highly developed a civilization as that of the Incas. But they were important because they served as a connecting link between the Incas and the great Maya civilization of Central America. (*See also* Incas.)

Most of the Indians of Peru and Bolivia still live in much the same way as their Inca ancestors did. They still rely for food upon the tiny grain *quinoa*, and on barley and potatoes. The potatoes are kept as *chuño*. This is made by freezing the potatoes, then thawing them and squeezing out the water. They become dark, shriveled, and cork-like, and will not spoil. Natives living near lakes obtain some fish and game birds. In the lower valleys they grow beans and corn.

Where rainfall is scanty, they irrigate their fields with water supplied by melting snow on the mountains. One of their peculiar implements is a foot-plow, worked by a team of two men and a woman. The foot-plow is a stout stick with a broad, pointed end and two projections. A man grasps one projection with his hand, and steps on the other to drive the stick into the earth. Another man does the same alongside, and the two pry up a clod of earth. A woman then pounds the clod into loose soil.

Houses are made of adobe or stone, with a thatched roof of grass or reeds. Doors are made of split cacti or hides. For fuel the natives use dried llama dung and the *tola* and *yareta* plants.

Clothing is made of wool, either from the llama or from the sheep. In the bitter winter weather and on great heights everyone wears a woolen cap with ear tabs. Over this the men wear a felt hat with a narrow brim. Women's hats have broad brims. The outer garment is a poncho, dyed red, green, or yellow. Women wear many skirts. The men wear trousers, slit down the back below the knee. The slit is lined with brightly colored cloth.

White Life and Activity

The life of the early white settlers, with its basis of Indian and Negro labor, set the pattern which still continues over much of the continent. The white people practice agriculture where conditions are favorable, and they undertake such manufactures as local resources make possible. In Argentina, Chile, Uruguay, and to some extent in southeastern Brazil, the white people participate in every kind of work. In other regions Indians, Negroes, and mestizos perform most of the manual labor, while the whites occupy themselves with management, business, politics, intellectual pursuits, and sports. Wealthy landowners are likely to spend little time on their estates. They prefer to congregate in the cities or travel abroad.

Scarcity of Industrial Cities

The unimportance of industry in South America, as compared with North America, is reflected in the small number of cities. South America has only four cities—Buenos Aires, Rio de Janeiro, São Paulo, and Santiago—with more than one million population. while North America has six. South America has about 60 cities with populations between 50,000 and 1,000,000, North America has about 275 such cities.

Of all the South American cities, only Buenos Aires, Rio de Janeiro, São Paulo, Montevideo, Santiago, and Valparaiso have much manufacturing though some of the smaller cities have small manufactures of articles for local consumption. Industrial development has been restricted by the lack of conveniently situated supplies of iron and by the poor quality of the coal. And though the continent has 12 per cent of the world's potential waterpower, only a small fraction of this is used. Most of the cities therefore are chiefly important as national and provincial capitals and as trading and shipping centers. In all of them the South American love of art is evident. Churches, public buildings, and plazas are made as beautiful as the city can afford. The large cities have splendid theaters and motion-picture houses. Bands play in the public squares and a gay, open-air life prevails wherever climate permits.

RIDER OF WEST ARGENTINA

Many of the gauchos or cowboys of Argentina are of white stock. Notice the woolen poncho this one is wearing.

Rural Life on Haciendas and Estancias

Life in the country presents marked contrasts to farm life in the United States. There are few small and medium-sized farms. The typical South American farm or ranch is a *hacienda* or *estancia* of several thousand acres. The center is the owner's spacious and comfortable home. Grouped around it is a cluster of workers' homes, barns, and workshops with perhaps a store. In many parts of South America no other centers of population exist; the haciendas take the place of towns.

In such districts peddlers travel about, selling articles which the haciendas do not provide. Dentists and doctors also travel from district to district, taking their equipment on pack animals. Even lawyers and notaries can be seen picking their way along the trails, with a typewriter strapped to the saddle

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Transportation and Communication

In a continent so largely occupied by forests and mountains, with a widely scattered population, the development of transportation has naturally not been the same as in the United States or Canada. Highways and railroads have been built only in regions offering sufficient traffic to warrant the expense. These are being extended constantly, as production increases.

For a long time, however, large parts of South America will continue to get along with those forms of transportation which best suit their topography and their economic position. In most of the high Andes, goods will continue to be moved over narrow trails by llama or burro trains and by human burden-bearers. In the sparsely peopled parts of the plateaus and plains, carts and pack animals will travel slowly over unsurfaced roads In the basins of the Amazon, the Orinoco, and the Plata, and on other lesser streams, traffic will continue to be carried cheaply and conveniently by water.

Inland and Ocean Waterways

In navigable rivers South America is well served on its Atlantic side. Ocean steamers can travel nearly a thousand miles up the Amazon to Manáos, and large river steamers can go 1,300 miles farther, to Iquitos in Peru. Smaller power boats can reach the foothills of the Andes The Orinoco is navigable by large steamers for 700 miles or more. Commercially, the most important waterway is the Paraguay-Paraná-Plata system, which serves a vast productive region.

The São Francisco in Brazil, the Essequibo in British Guiana, and the Magdalena-Cauca system in Colombia are also important routes. Lake Titicaca, high in the Andes, is traversed by steamers that connect the railways of Peru and Bolivia. On the Pacific side, the only important river highway is the Guayas, navigable for 160 miles.

On the oceans, regular and frequent steamship service connects South American ports with Europe, Asia, and North America, as well as with one another. Coastwise shipping carries most of the trade between the South American republics, since road and rail connections between them are few and land transportation is costly. Tourist travel, especially from the United States, has greatly increased in recent years.

The Panama Canal has been an important factor in promoting trade between the west coast of South America and the United States. Before the canal was built, a trip from New York City to Valparaiso was 9,000 miles by Cape Horn; by way of the canal it is only 5,100 miles. (*See* Panama Canal.)

Costliest Railroads in the World

The story of railroad building in South America is an epic of skill, daring, and endurance. The massive Andes, with their steep slopes and great heights, make railroads exceedingly difficult to build and costly to operate. All the equipment and nearly all the fuel have to be imported. Tunnels have to be driven through the mountains, shelves blasted out of their sides to support the roadbed, and bridges built across the chasms. In many places the grades are so steep that locomotives cannot get enough grip on the rails to haul up the cars, and engineers have to use cogways and cableways.

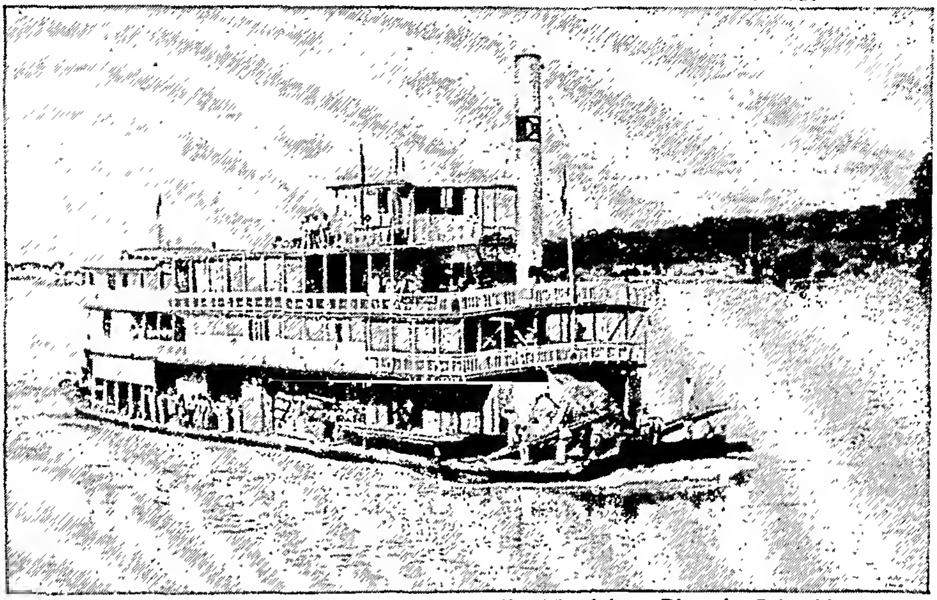
Yet two transcontinental lines exist. The Transandine railway connects Valparaiso, Chile, with Buenos Aires, Argentina. The other line is from Buenos Aires through northern Argentina into Bolivia. From La Paz, Bolivia, there are three routes to the Pacific. One goes to Antofagasta, Chile; another to Arica, Chile; and a third, after crossing Lake Titicaca by steamer, goes to Mollendo, Peru. A third transcontinental railway from Santos, Brazil, will connect with Arica when a link in Bolivia is completed.

The 886-mile journey from Buenos Aires to Valparaiso takes a day and a half. The train crawls upward to a tunnel 10,452 feet above sea level. The 1,663 miles from Buenos Aires to La Paz take three days.

The Peruvian Central, extending from Callao on the Pacific coast into the high Andes, is the highest railroad in the world and one of the most remarkable. In its first 106 miles it climbs more than 15,600 feet—nearly three miles. In this stretch alone are 65 tunnels, 67 bridges, and 16 switchbacks. Another stupendous railway connects Guayaquil, Ecuador's seaport, with Quito, its capital in the Andes. Numerous shorter railroads exist in the narrow coastal valleys of the Andean countries, and elsewhere where economic development warrants their construction. In Chile a longitudinal line extends through the beautiful Central Valley.

In eastern South America railroad nets exist where topography and climate have permitted the development of large farming and live-stock industries. On the wide flat plains, railways radiate in all directions from Buenos Aires and Rosario. Similar networks exist on the lowlands of Uruguay, with Montevideo as center; and on the southeastern part of the Brazilian plateau, especially around Rio de Janeiro and Santos-São Paulo. Short lines occur elsewhere where traffic is sufficient to maintain a railway. Most of these are mere stubs that run inland from the seacoast to some special source of traffic and then stop. The total railway mileage for the entire continent is little more than 60,000 miles. Five-sixths of this is in Argentina, Brazil, and Chile. A serious difficulty is the great variety of gauges, which makes it necessary to reload shipments frequently.

TYPICAL SOUTH AMERICAN RIVER STEAMER



This boat is carrying freight and passengers up the Magdalena River in Colombia. Similar craft ply the waters of the Orinoco, Amazon, and Paraguay rivers. With their flat bottom, stern paddle wheels, and high stacks, they resemble the old Mississippi steamboats.

Far-Flung Airplane Service

In striking contrast to the limited railroad development is the tremendous recent expansion of aviation. No other continent leans so heavily on the airplane for the transportation of passengers, mail, and express freight. The airplane was an incalculable boon to South America. It costs practically nothing for right of way, and flies over mountains and jungles almost as readily as it does level ground. Today every important city has airplane service, as does every inland district where any considerable number of white people live. The airplane has aided materially in developing formerly inaccessible areas, especially some rich in mineral resources.

The first commercial air service in the Western World was installed in Colombia in 1920. This reduced travel time between Barranquilla, the chief port, to Bogotá, the capital in the interior highland, from nine days to less than three hours. International air services now connect all the republics with the United States, Africa, and Europe. By Pan American clipper, Buenos Aires can be reached in less than two days from New York City, whereas the ocean journey takes nearly three weeks.

Progress in Building Motor Roads

Just as South America has turned to the most modern means of transportation, the airplane, to solve part of its transportation problem, so it is also turning to another modern means, the automobile and the truck. The airplane serves to connect the great primary centers and to transport passengers and a limited amount of goods. Where railways are impracticable because of their cost, motor roads are being built to connect both the primary and the secondary centers and to carry bulky freight. Nearly every country is spending more and more of its national income in building roads.

Uruguay and Argentina have made the greatest progress, because road building is easier on their flat plains and because their farms and ranches supply enough traffic to warrant the expense. Brazil too has been extending its system of roads in the populous southeast, and Peru has built a spectacular highway over the Andes from Lima to Pucallpa, on a tributary of the Amazon.

In most regions road building, like railway building, is difficult and expensive. In the Andean countries, the mountains and the great distances between centers of population make the construction of motor roads almost prohibitive. In the wet tropical regions, swamps, heavy rainfall, and the lack of materials are similar obstacles. Hence it is not surprising that the entire continent has only about 500,000 miles of road—less than one sixth as much as the United States—and that much of this mileage is unpaved and impassable to motor vehicles except in favorable weather.

The Pan American Highway

The most ambitious road-building project is the Pan American Highway, proposed at the Fifth Pan American Conference in 1923. Though each republic is responsible for the links of the highway within its borders, the nations work together on problems of technology and financing in meetings of the Pan American Highway Congress, a part of the Organization of American States. In the south and east, Rio de Janeiro is connected by fair roads with Buenos Aires. There is a ferry link across the Rio de la Plata. A partly paved road connects Buenos Aires with Santiago, Chile. This uses the Transandine railroad tunnel. Mountain roads are blocked with snow in winter. On the Pacific side, an all-weather road extends from Santiago through Peru to the Ecuador border. A difficult mountain road branches off to La Paz, Bolivia. In the north, Quito in Ecuador is connected through Bogotá, Colombia, with Carácas in Venezuela by the Simón Bolívar International Highway, which is also called the *Carretera de los Andes.*

Ecuador still has a 100-mile gap in the road to the Peruvian border. The most serious gap, however, is the 300-mile stretch from Panama to a connection with the Bolívar Highway. Most of the route is through an unexplored, forested swamp. A ferry service from Cristobal in Panama to a Caribbean connection with the Bolívar Highway may be used instead of trying to build a road on such land.

Improvements in Communication

Until recent years communication by mail and newspapers has been limited by lack of transportation in the less settled regions. Even telegraph service was difficult to provide in many places, because the lines could not earn enough to pay for their cost The various governments established lines and services for official needs; but these lines left many communities hundreds of miles away from any modern means of communication. Telephones were limited to the cities, and many cities were not interconnected.

Today the airplane transports mail and newspapers quickly between all important centers, with immense benefit to business, public affairs, and general enlightenment. Radio has been equally helpful, both in broadcasting news, and in providing telephone service between places not connected by wire. Every town in the Amazon Valley, for example, now has radio telephone connections. Wire telephone and telegraph services have also been greatly extended.

South America has had cable connections with other continents for many years. The radio made intercontinental telephone connections possible. It also brought in many points not served by cable.

Every nation has its radio broadcasting services Brazil introduced television transmission in 1950, and Colombia and Venezuela built stations in 1952 United States correspondents broadcast important news that reaches all parts of North America. Foreign nations, in turn, direct a continuous flow of shortwave programs to South America to win the sympathies of its people. Broadcasts from the United States seek to strengthen inter-American unity.

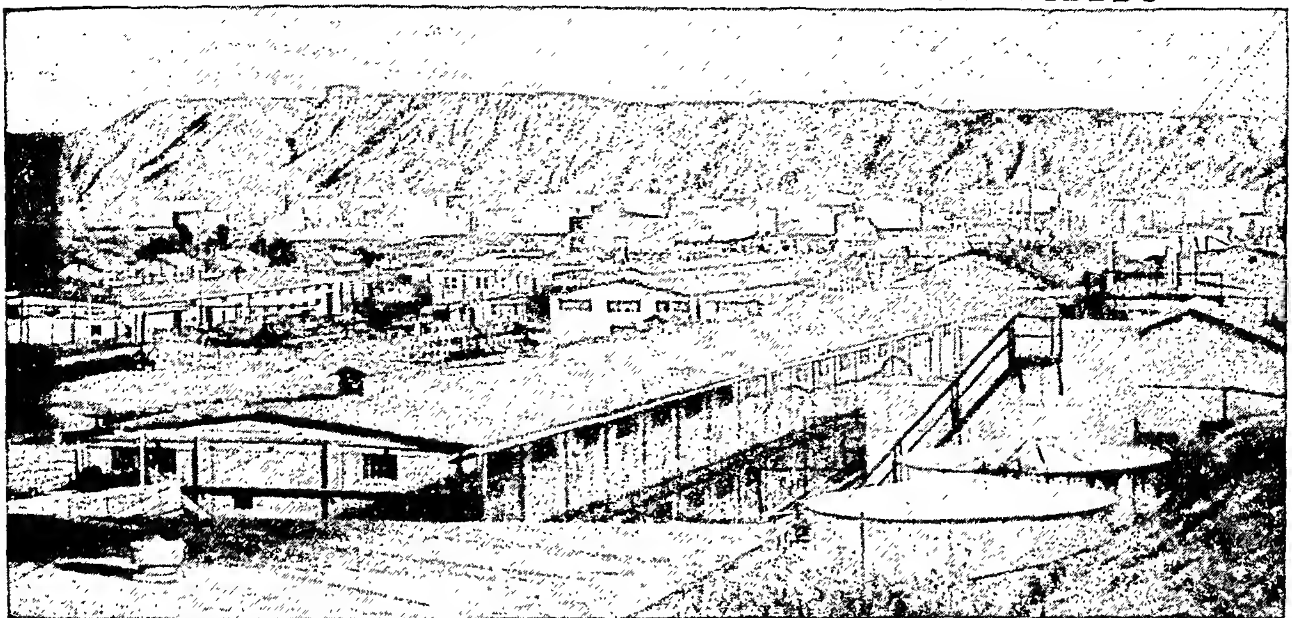
Production and Foreign Trade

SOUTH AMERICA'S role in world economy is that of a vast reservoir of food, minerals, and other raw materials. It already supplies about 10 per cent of the world's exports, and this proportion can be greatly increased as its resources are further developed. Of world imports, it takes only about 7 per cent. The difference enables it to pay interest and dividends on the billions of foreign capital invested in its business enterprises and government loans.

Agriculture, Crops, and Livestock

Agriculture is by far its greatest source of wealth. Yet only between 4 and 5 per cent of its area is under cultivation, and 90 per cent of this cultivated area is in two countries—Brazil and Argentina. From this small fraction of the continent come the exports which are its lifeblood; for three fourths of the

ONE OF SOUTH AMERICA'S MANY RICH OIL FIELDS



These are storage tanks at Talara on the extreme northern coast of Peru. Oil from nearby wells is refined here and loaded into tankers in the harbor. Petroleum accounts for about half of Peru's mineral production. It was discovered by the early Spaniards, who used it only to waterproof the material with which they caulked their ships.

exports are the products of farm and range. More than half of the cultivated land is devoted to raising corn, coffee, wheat, and the alfalfa which pastures the great herds of live stock. A small fraction grows flaxseed, cacao, cotton, and sugar, which are also important exports. The rest of it grows crops chiefly for home consumption. Among these are tobacco, olives, peanuts, tropical fruits and vegetables, citrus fruits, grapes, and cereals. Cattle and sheep raising is most important in Argentina and Uruguay, and herds are increasing in Brazil and Colombia. During the second World War, world shortages of oils, rice, and fibers led to increased growing of castor beans, sunflower seeds, rice, sisal, jute, and other hard fibers.

The thinly populated continent can ship a high percentage of its crops. About 75 per cent of the world's coffee flows from its tropical hills. The tropics also export their cacao, fruits and nuts, cotton, and sugar. The broad southern plains send the world a far larger share of their grain and livestock than do the North American plains. By the late 1940's they were shipping nearly half of all meat entering world trade.

Mineral Production

Every country has mineral resources, but mining is of chief importance in the Andean countries. All the world's natural sodium nitrate comes from Chile, but markets for this valuable fertilizer have been much reduced by the manufacture of synthetic nitrogen compounds in the chief consuming countries. Bolivia supplies 20 per cent of the world's tin. Chile, with Peru and Bolivia, supplies 20 per cent of its copper. Peru is the leading producer of bismuth and of vanadium, an indispensable alloy metal for the steel industry. Colombia yields most of the world's emeralds and a large part of its platinum. Brazil is a chief source of industrial diamonds and has the world's largest manganese deposits. All the Andean countries yield some gold and silver. The Guianas supply gold, diamonds, and bauxite (aluminum ore).

In petroleum production, South America is one of the major world sources. Venezuela, Colombia, and Peru are the chief producers, but there are deposits also in Bolivia, Argentina, and Ecuador. Coal beds occur in Brazil, Chile, Argentina, Colombia, and Peru. For the most part they are thin and poor as well as remote from transportation. The shortage of convenient coking coal has delayed development of the continent's iron deposits. Chile's high-grade ore is chiefly shipped to the United States. Mining of Brazil's vast deposits was advanced during the second World War. After the war, steel companies from the United States began developing high-grade iron ore ranges south of the Orinoco River in Venezuela. They included Cerro Bolívar, one of the greatest and richest mountains of ore in the world.

Forest Products

Nearly half of South America is covered with forests—a far greater proportion than in any other continent. The products of these forests are varied and important, but they form only about 10 per cent of the total trade. Quebracho, a tanning material obtained from the heartwood of the quebracho tree of Argentina and Paraguay, ranks highest in value of forest products exported. It is marketed either in the form of logs or bricks of the dried extract. Rubber, balata (an elastic gum like gutta-percha), Brazil nuts, vegetable wax, ivory nuts, and cabinet woods are other leading items of export, chiefly from Brazil. *Yerba maté* is exported from Brazil and Paraguay, chiefly to other South American countries.

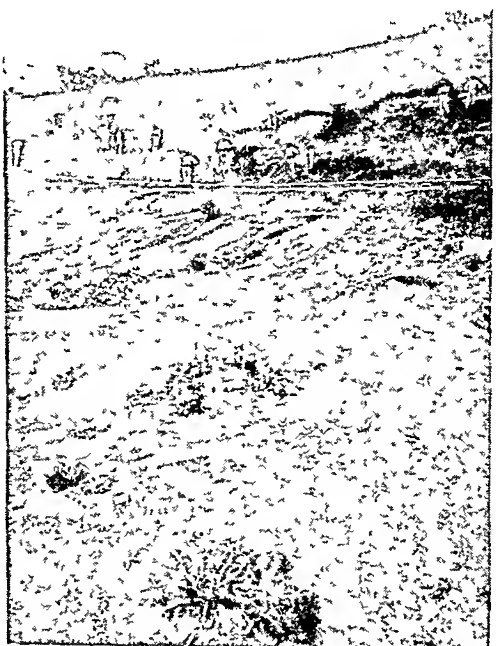
Trade Handicaps; Manufactures

A fact which places South America at a disadvantage in world trade is that most of its countries depend largely on the export of one or two products or

groups of products. Argentina depends on grain, animal products, and oil seeds; Brazil on coffee and cotton; Chile on copper and nitrates; Bolivia on tin; Colombia on coffee and petroleum; Ecuador on rice and cacao; Paraguay on cotton and quebracho; Peru chiefly on cotton, copper, and sugar; Uruguay on meat and other animal products; Venezuela on petroleum.

Until recent years the nations of South America did little manufacturing. Lack of skilled labor, of coking coal, and of capital tended to prevent any considerable growth of industry. But disturbances in foreign trade and shipping before and during the second World War led several countries to build new industries and make themselves more nearly self-sufficient. In this development the "A B C countries"—Argentina, Brazil, and Chile—have led. Peru also has a considerable industry. Manufactures are of two types: the processing of raw materials for export and the manufacture of consumption goods for domestic use. The first includes meat packing and refrigeration, flour milling, ore concentration, and similar processes. Products for home consumption include cotton cloth, shoes and other articles of clothing, furniture, cement and other building materials, soap, cigars and cigarettes, prepared meats, tires, paints, matches, paper, glass, and household utensils. Automobile assembling has also become a considerable branch of industry.

MANGANESE DEPOSIT IN BRAZIL



Steelmakers need manganese and Brazil's output has been booming. The deposit shown here is one of many in the province of Minas Geraes.

There is however virtually no heavy industry. So all the South American countries have to import locomotives, railroad cars, motor vehicles, and all kinds of agricultural and industrial machinery. Radios, sewing machines, refrigerators, and other kinds of household equipment are for the most part imported, though such manufactures are increasing. Despite the growth of manufactures, a good share of the imports consist of shoes and other clothing, foods, beverages, and tobacco. Such imported goods are, of course, luxuries which can be bought only by the well-to-do classes of the cities.

Trade with the United States

The United States is both South America's best customer and chief source of supply. Before the second World War it took between one fourth and one fifth of the exports and supplied more than one fourth of the imports. During the war and early postwar years, it took a third or more of the area's exports and furnished about half of the imports. Great Britain, leader in the trade before the first World War, holds second place. Before the second World War broke out in Europe in 1939, Germany was a close third, though it sold South America far more goods than it was able to buy. France, Italy, and Japan formerly accounted for most of the rest of the continent's foreign trade Only about one tenth of all the trade is between nations within the continent.

United States trade with South America consists essentially of the exchange of tropical foodstuffs and raw materials for manufactured and semimanufactured products. The United States takes a high proportion of the exports of the metal-producing countries — Chile, Bolivia, and Peru. It is also the chief purchaser of such tropical crops as coffee and cocoa. Hence it takes the lion's share of the exports of Brazil and Colombia. It buys a smaller share of the exports of Argentina and Uruguay. Their meat, animal products, and grain compete with the same commodities from the United States in the world market These lands find their chief outlet in Europe.

In return for South American imports, United States manufacturers export automobiles, trucks, mining and electrical machinery, agricultural equipment, chemical products, iron and steel, textiles, wheat flour, and many miscellaneous items

This trade forms a considerable part of the total foreign trade of the United States Before the second World War it made up about 12 per cent of the total imports and about 10 per cent of the total exports. In 1950 and 1951, the United States was sending nearly a sixth of its exports to South America and receiving about a fifth of its imports from that area. United States trade with South America amounts to about 60 per cent of its Latin American trade.

The Big Four in South American Trade

Four South American countries handle between 80 and 90 per cent of the continent's foreign trade. Argentina usually ranks first with about a third of both exports and imports. Brazil supplies between a fourth and a fifth of the exports and takes a quarter of the imports. Venezuela's vast oil production and iron-ore output have recently put it on a level with Brazil in exports, but it takes less than a sixth of the imports. Chile handles only about 6 per cent of both exports and imports.

Wartime Trade and Economic Advancement

When the outbreak of war in Europe in 1939 upset the normal course of South American trade by cutting off many of its markets, the United States took far-

reaching steps to help its neighbors solve their economic problems. Diplomatic and commercial officials of the various countries conferred frequently to find ways in which South American surpluses might be marketed. It was feared that a successful Germany might bring South American countries under its economic and even political control, if they were forced to sell their export products in an unprotected market.

When war involved the Western Hemisphere after December 1941, the United States took the lead in an inter-American program, to speed production of strategic raw materials, such as rubber, tin, manganese, tungsten, copper, iron, and antimony. The program further aimed to increase and improve industry, agriculture, and communications, in order to raise the standards of living of the peoples. The Export-Import Bank made loans to the republics to finance large projects. Mining machinery, trucks, and railway cars were made available. Factories were equipped to make textiles, storage batteries, paints, brick, and other needed consumer goods. Engineers, economists, and other specialists were sent to study the resources and market possibilities.

COTTON BALES FOR DISTANT MARKETS

Brazil, Peru, and Argentina lead in the production of cotton. Here we see bales being transferred from a lighter to a ship at anchor. On the west coast of South America protected harbors are rare, and ships are loaded and unloaded in open roadsteads.

South America's foreign trade increased greatly. In dollar value, it was between three and four times higher in 1950 than in 1938. As European countries recovered economically, they began buying and selling more in the area, seeking to regain their prewar share of this trade (*see* International Trade; Latin America).

Natural Regions: Their Climates and Resources

In trying to understand South America, one must constantly keep in mind that it is not one country, but thirteen. These thirteen countries differ from one another almost as sharply as do the various countries of Europe. Underlying all other differences are the differences of physical makeup, climate, and natural resources.

South America falls into seven main natural divisions. Four of these are the highland masses which make up the rim of the continent: the Andes on the west and north; and on the east the Guiana Highlands, the Brazilian Highlands, and the Patagonian Plateau. These highlands enclose the vast interior lowlands which make up nearly three-fourths of the entire area: the Orinoco basin, the Amazon basin, and the Paraguay-Paraná plains. (*See* maps on S-255-56.)

1. THE WESTERN MOUNTAIN BELT

The Andes are the backbone of the continent. They stretch from the Caribbean coast to Cape Horn like a huge sickle, with the curve in the north and the straight handle in the south. The slopes toward the Pacific are extremely abrupt. Except in a few places the coastal plain is only a narrow strip. The eastern slopes are gentler and wider.

Volcanic eruptions and earthquakes are frequent, and sometimes destroy whole cities. In many places houses are only one story high because low houses are less likely to fall, and are less dangerous to their inhabitants if they do. (*See also* Andes Mountains.)

Northern Andes and Their Coastal Plains

In the north, the Andes rise from the Caribbean in three main ranges, rising to heights of more than 18,000 feet in Ecuador. Between the ranges in northern Colombia are the valleys of the Cauca and the Magdalena rivers. The Eastern (Oriental) range divides into a wide V which encloses the Maracaibo basin. The eastern side of the V is continued along the Caribbean coast in a double range. Gold, silver, copper, and iron exist in the mountains. Petroleum deposits in the Lake Maracaibo region, in Trinidad, and in the Magdalena valley are worked intensively.

The Caribbean coast has a rainy season from April to November. The rest of the year the climate is dry and hot. Maracaibo is the hottest place in the continent, with a mean temperature of more than 83° F. Much of the land is a savanna of mixed grass and trees, but coconut palms, cacao, bananas, mangoes, oranges, and lemons are grown in favorable spots. A short journey up the mountains brings the traveler to a semitropical climate at about 1,300 feet. Here coffee and sugar cane flourish, up to about 5,000 feet. Above this, rice and other cereal grains are grown, as well as tobacco, cotton, and fruits.

The narrow Pacific coastal strip of Colombia lies in the equatorial doldrums belt. Warm rain falls every day. Tropical forests cover the land, and the region

is unhealthful. Negroes and mulattoes make up much of the population. A little gold and platinum are mined; other products are coffee, cacao, and vegetable ivory.

Farther south, in Ecuador, the Pacific coastal plain reaches its greatest width, 80 to 100 miles Much of it is covered with tropical rain forest, which yields vegetable ivory and the toquilla fiber of which Panama hats are made. Coffee, cacao, and cotton are grown on large estates. But the lowlands are unhealthful and most of the people live in the highlands, where they grow subsistence crops of barley, corn, potatoes, and beans. The climate ranges from tropical heat and abundant rainfall at sea level to intense cold on the high Andes. Here the two famous volcanic peaks, Chimborazo and Cotopaxi, tower to about 20,000 feet. (*See also* Colombia; Ecuador; Venezuela.)

The Central Andes and Their Plateaus

The highest and broadest part of the Andes is the central part, in Peru, Bolivia, and northern Chile and Argentina. To the west, between the Andes and the low Coastal Range, lies a long desert plain. Between the ranges of the central mountain mass are broad plateaus, 11,000 to 15,000 feet high. The ridges and many volcanic peaks tower above 20,000 feet. So great is the altitude that many travelers have to break their journey half-way up for a day or two, to become accustomed to the change. The Indians are remarkable for their large chests, which enable them to breathe greater quantities of the thin air.

Grain, cotton, and fruit are grown by irrigation in the many short river valleys of the almost rainless Coastal Desert of Peru. The plateaus receive moisture enough from melted snow to grow hardy food plants, such as potatoes and barley, and to raise sheep and llamas. The region has great mineral wealth, chiefly in petroleum, copper, tin, and silver.

On the slope from the central highlands down to the Amazon basin is a narrow belt of subtropical and tropical vegetation, called the *montaña* in Peru and the *yungas* in Bolivia. The hot, wet climate favors the growth of rubber, balata, and the coca shrub, source of cocaine. Cassava, sugar cane, coffee, corn, and many other crops are raised. But development is limited because of the difficulty of reaching markets, and the population is sparse and isolated. (*See also* Bolivia; Peru.)

The Southern Andes and Coastal Regions

The southern part of the western mountain belt, which makes up Chile and the western margin of Argentina, has the Andes on the east and the low Coastal Range on the west. All the Chilean coastal ledge north of latitude 30° S. is a hot desert, the Atacama. The utter lack of rain has preserved immense beds of nitrate of soda, which is one of Chile's principal sources of wealth.

The Central Valley, between the Coastal Range and the Andes, is the richest part of Chile for agriculture, and it supports most of the population. It is so narrow that from almost any point on the coast voyagers can see the snow-capped Andes to the east. Nearness to the sea provides an even, Mediterranean climate, without violent seasonal change.

South of the Central Valley, moisture-laden westerly winds drench the seaward slopes of the Andes the year round. Much of the precipitation falls on the crests as snow, and the snow changes to ice in every valley. Hence the coast has many glaciers and icebergs. Moraines across the valleys hold back water from the glaciers above and form many beautiful lakes. (*See also* Chile)

2. THE ORINOCO RIVER BASIN

The great arc of the Andes in Colombia and Venezuela makes a rim around the northern and western edges of the Orinoco basin, an area of about 365,000 square miles (*see* Orinoco River). The southwestern part lies in Colombia, the remainder in Venezuela. From the Orinoco north to the coastal ranges the savanna (*llanos*) is grass-covered, with trees along the many streams.

In summer, which occurs here at the same time as in North America, the entire basin lies in the belt of drenching equatorial rain and much of the land becomes a swamp or inland sea. In winter the llanos get little rain, and become dry and brown in the tropical heat. These conditions are a great handicap to cattle raising, which is the chief occupation. Insect pests, disease, poor transportation, and limited local demand for meat and hides are further drawbacks. The population is sparse, and consists mostly of Indians. (*See also* Colombia; Venezuela.)

3. GUIANA HIGHLANDS AND COAST

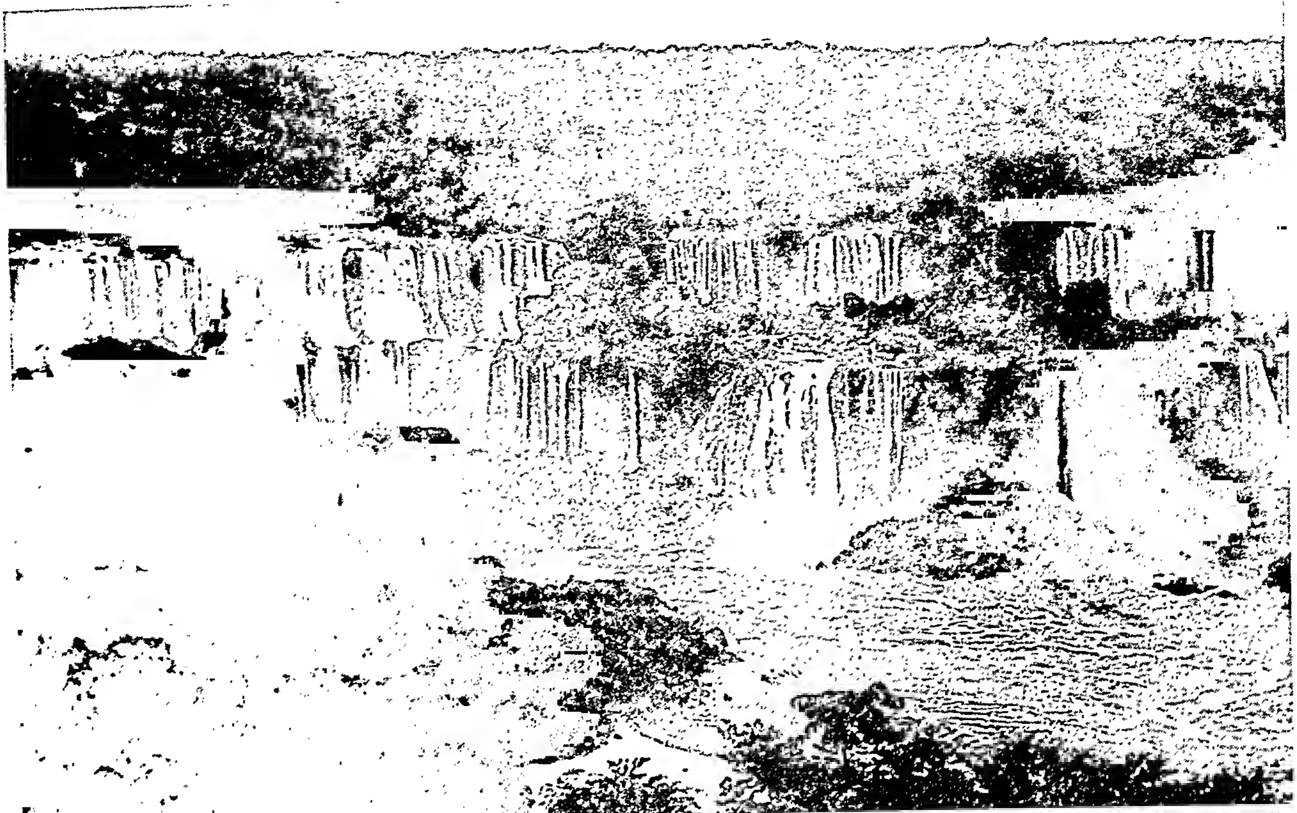
Southeast of the mouth of the Orinoco River the Guiana Highlands extend over nearly 700,000 square miles. The backbone of this region is one of the "islands" of old rock which form the foundation of eastern South America. Politically it is shared by Venezuela, Brazil, and the Guianas. Many of the mountains have been worn to rounded, domelike shapes by the wash of tropical rain through the ages Only a few of them rise more than 5,000 feet. They contain gold, diamonds, bauxite (aluminum ore), manganese, and mica. Between the mountains is a tangle of streams, with tropical forest wherever trees can find a foothold. Superb waterfalls mark the descent of the rivers from the mountains.

From this mountainous core, the land slopes off toward the north into a plateau, and then down to a narrow coastal fringe. Here the climate is steaming hot, with tropical rain from May to October and trade-wind rain in the remaining months. Agriculture is confined to clearings. Extensive diking and drainage are necessary. Sugar is the principal crop, with rum and molasses as by-products. Rice, bananas, and coffee are also grown. The forests are rich in cabinet woods and balata. (*See also* Guiana.)

4. THE AMAZON RIVER BASIN

Into the Amazon River drains heavy rainfall from an area estimated at 2,500,000 square miles. The headwaters in the Andes belong to Colombia, Ecuador,

THE BROAD AND MAJESTIC IGUASSÚ FALLS



Where the Iguassú River of Brazil descends from the highlands to the Argentine plains, it drops about 200 feet in one of the world's grandest cataracts. The falls are about two and a half miles wide. A few miles below, the Iguassú joins the Paraná.

Peru, and Bolivia; the rest of the basin belongs to Brazil. A neighboring basin of about 345,000 square miles in Brazil is drained by the Tocantins River, which is called the Pará where it flows into the Atlantic. The Pará is separated from the Amazon by Marajó Island, which is as large as Maryland.

All year long the temperature holds to a daily average between 75° and 80° F. In most localities the precipitation is about 80 inches a year, but in some places it rises to 150 and even 200 inches. This hot, wet climate has filled the region with the world's greatest tropical rain forest, or *selva*. During the rainy season from December through April the rivers rise 20 to 50 feet higher than their low-water level, and floods cover hundreds of thousands of square miles. The northern part of the basin lies on the southern slope of the Guiana Highlands, and has a dry season, just as do the llanos of the Orinoco.

The soil is mostly of the laterite type and not good for agriculture (*see* Soil). It loses fertility after one or two crops, and the natives have to clear fresh land nearly every year for their little patches of crops. Because of the enervating climate, insect pests, and tropical diseases, the vast region is left largely to the Indians and people of part Indian blood. The few whites live mostly in towns and plantations along the rivers. They ship rubber, timber, Brazil nuts, and other forest products. The Ford Motor Company maintained an experimental rubber plantation on the Tapajóz River, a tributary of the Amazon, from 1927 to 1945, when the Brazilian government bought the project. (*See also* Amazon River; Brazil.)

5. THE BRAZILIAN HIGHLANDS

The "bulge" of Brazil, east and south of the mouth of the Amazon River, has as a foundation the old worn-down mountains of the Brazilian Highlands. Most of it is a rolling plateau, averaging about 3,000 feet above sea level. The highest peaks range between 7,000 and 9,400 feet. This elevation gives some relief from the tropical heat which prevails at sea level. From May to November, the southeast trade winds yield good rainfall as they mount to the plateau. Over the plateau, the effect of rising ground ceases, and local thundershowers produce only from 10 to 20 inches of rain for the winter season. In summer, from November to April, the belt of equatorial rain lies over the region and doubles the amount of rain.

A striking exception to this climate occurs in the semiarid *caatinga* region, in the north. This region is lower than the plateau to the southeast, and hence receives no steady rainfall from the trade winds. Thundershowers occur, but they are erratic. The general dryness is aggravated by lack of plant cover on the land. Rain runs off or evaporates almost as fast as it falls.

By far the most important portion of the Brazilian Highland is the Central Plateau of eastern Brazil. On or near its margin are the largest cities, much

of the manufacturing and trade, and a large part of the population. The interior produces more than half of the world's coffee. The southern portion of the coastal strip and the adjoining highlands also grow cotton, sugar, rice, beans, tobacco, and cacao. On the northern and western slopes of the highlands, an important live-stock industry has developed. *(See also* Brazil.)

6. THE PARAGUAY-PARANÁ PLAINS

West and south of the Brazilian Highlands lies the most important lowland region in South America. Much of the northern portion is occupied by the Gran Chaco. The southern portion is the Pampa, the only moderate-climate lowland on the continent. The rest consists of the rolling grassy plains of Uruguay, eastern Paraguay, and the Argentine Mesopotamia.

The Wild Chaco and Its Resources

The Gran Chaco ("hunting ground") is shared by Paraguay, Bolivia, and Argentina. Its total area is about 400,000 square miles. Here the hot, wet climate of the tropics changes to the cooler and drier climate of the middle latitudes. In summer it receives heavy rain as far south as the Pilcomayo River and good rain farther south. Then the generally flat land is flooded and the sluggish, shallow rivers thread their way through extensive swamps. In winter, the rainfall is only between 10 and 20 inches along the Paraná River, and decreases to almost nothing in the west. The heat and abundant stream water are enough, however, to support a dense forest of subtropical trees along all the rivers. The most valuable tree is the quebracho. Between the rivers is grassland. The foundation of sedimentary rock contains petroleum. Until recently the Chaco has been left to the Indians, except for a few traders and immigrants.

The Rich and Populous Pampa

South of the Gran Chaco lies the flat prairie land called the Pampa. Most of this region of about 250,000 square miles is much like the plains of North America between the Missouri River and the Rocky Mountains. It supports a population about equal to that of Texas, Oklahoma, and New Mexico on its fertile farm and grazing land and in its prosperous cities. The westerly winds bring little rain, for they have dropped most of their moisture on the high mountains, but cyclonic storms draw moisture enough from the Atlantic for grass, grain, and flax.

The western margin of the Pampa, where the plain merges into the Andes, is a dry, broken region called the *monte*. It stands a mile or more above sea level, and the rainfall in many places is less than ten inches a year. Irrigation from artesian wells and some of the short rivers from the mountains produces special crops such as the grapes grown around Mendoza.

The southern part of Uruguay is a plain like the Argentine Pampa; the rest is a rolling grazing land. A rainfall ranging from 35 to 60 inches a year supports trees along the streams and rich grass everywhere. The temperature ranges between an average of 71° F. in summer and 50° F. in winter, with rare frosts.

Thanks to their agricultural possibilities and the favorable climate, these plains support a large population. They have two large cities, Buenos Aires and Montevideo, as well as many smaller ones. *(See also* Argentina; Paraguay; Uruguay.)

7. THE PATAGONIAN TABLELAND

South of the Colorado River, the plains rise to the plateau of Patagonia, which is nowhere higher than 5,000 feet. This is a vast bleak region of more than 300,000 square miles, nearly all belonging to Argentina. The land is deeply carved by rivers fed with melted snow from the Andes. Rainfall ranges from 8 inches in the central portion to 60 inches in the south. Raising and slaughtering sheep is the only considerable industry. *(See* Patagonia.)

South of the Strait of Magellan a continuation of the old plateau has sunk until only mountain tops rise above the water. These, with the drowned southern tip of the Andes, form the archipelago of Tierra del Fuego, or "land of fire," so named by the discoverer, Magellan, from the many native camp fires observed. The region is divided between Argentina and Chile. Over most of it precipitation is plentiful. Because of the surrounding ocean, the temperature does not drop on the average below 31° F. even in the depth of winter in July. Sheep and cattle are raised and some beech and pine are cut.

On one of the southernmost islands is Cape Horn, the tip of South America. Here the westerly winds have an unbroken sweep around the earth and acquire terrific force. Howling gales and mountainous seas usually greet the few mariners who try to round the Horn. In sailing-ship days, this passage was considered one of the most hazardous in all the world.

THE STORM-WRACKED TIP OF THE CONTINENT

This view of Cape Horn is one of the rarest photographs ever taken. The Cape is wrapped in almost perpetual mist and storm and the few ships that brave its roaring gales seldom catch more than a glimpse of the gaunt outline.

The Varied Array of Plants and Animals

Human activity throughout the continent has been strongly influenced by the native plants and animals. In the equatorial forests plants grow so rankly that they almost crowd man out. On the other hand, the fertile grasslands of the Argentine Pampa have drawn millions of immigrants. Of great significance too for the life of the original Indian inhabitants was the fact that they had no horses or cattle until the white conquerors brought them from Europe.

South America is the native home of many plants of vast importance to the world. Among its gifts to mankind are rubber, several varieties of cotton, tagua nuts (vegetable ivory) for buttons, and the quebracho extract which is one of our most useful tanning materials. South American food plants which have spread to other parts of the world are potatoes, sweet potatoes, tomatoes, kidney and lima beans, peanuts, and manioc or cassava from which we get tapioca.

Among the beverages and flavoring materials that we owe to South America and tropical regions of North America are cocoa and chocolate, cola drinks from the kola nut, sarsaparilla, vanilla, and the tonka bean. In the list of drugs are quinine, cocaine, ipecac, and various balsams.

Some of the native animals yield fine fur and wool. Most important of these are the llama and its relatives, the alpaca, the vicuña, the *misti*, and the *huarizo*. The last two are crosses between the alpaca and the llama. Other animals prized for their fur are the chinchilla, the coati, the fox, the jaguar, the leopard cat, the nutria or coypu, the otter, the ocelot, the puma, the raccoon, the skunk, and the wolf. The guanaco, once a source of both fur and wool, is now scarce. The peccary, or wild pig, furnishes fine leather for gloves; and snakeskins are made into women's shoes and other articles.

THE USEFUL BABASSU PALM

From its leaves, the people of the Amazon Valley make baskets, mats, and sandals. Its trunk serves as firewood. From its nuts they get food and oil. The oil is a valuable export.

Life in the Amazon Rain Forest

The greatest variety and profusion of plant and animal life are found in the equatorial rain forest, or selva, within 10 degrees of the Equator. Most of this rain forest is in the basin of the Amazon, but there are similar forests in parts of the Orinoco basin and Guiana, on the Pacific coast north of the Equator, and on parts of the Caribbean coast.

Almost everywhere in the Amazon basin, except on the margin, the continuous heat and abundant moisture have packed trees and other plants as closely together as they can find footing and a bit of sunlight. Men can scarcely squeeze between the towering tree trunks. Whatever open space is left is laced across with lianas (stout vines). Plants which would be only bushes in more open country here grow to considerable height to reach sunlight. The slimy ground below is covered with plants which can live without much light.

Among the tallest trees are the castanheiro, source of Brazil nuts; the sapucaya or cream-nut tree; the silk-cotton tree (kapok); and various fig and garlic trees. One species of fig tree (*Hevea brasiliensis*) yields the latex or milk which gives us rubber (*see* Rubber). The vegetation of medium height includes palms, the wild chocolate or cacao, bamboo, and wild plantains. The ground level is packed with ferns, begonias, pansies, iris, and members of the amaryllis, lily, and pineapple families. Most of the trees are hardwoods, but they remain green the year round and do not shed their leaves. Among them are valuable furniture woods, such as rosewood and snakewood. Other useful trees and shrubs are the castilloa, which yields an inferior rubber called *caucho;* the bullet tree, which yields balata; various palms, such as the babassu, whose nuts furnish oils; the *Dipteryx odorata*, which gives us the tonka beans used as a perfume base and a substitute for vanilla; and the cassava or manioc shrub.

Where rivers break the forest, gorgeous flowers line the banks. The water is covered with water-lilies, including the giant *Victoria regia* (for picture, *see* Water-Lily). In the lowest and most swampy portions of the basin, mangroves strike their many branchlike roots into the ground. Orchids grow everywhere, high on the trees.

Swarming Mammals and Birds among the Trees

Rich vegetation, plentiful water, and continuous heat produce an abundance of those animals that can get about in the forest. But large mammals are few.

The largest is the tapir; it lives in the giant cane grass along the edges of streams. The trees are thronged with monkeys. Jaguars, pumas, and ocelots are among the cats. Other flesh-eating mammals are kinkajous, otters, ferrets, and a few weasels.

MYSTERIOUS BEAKS

No one knows why the toucans have such big beaks. Numerous species live in the tropical forests, the largest about two feet high.

Squirrels, rats, mice, porcupines, and other rodents abound. Among them is the largest rodent known, the capybara, which the natives eat. The paca, a spotted rodent about two feet long, is also highly prized as food. Another gnawing animal is the paca's close relative, the agouti.

The equatorial forest is a paradise for birds. Parrots, macaws, toucans, and other fruit-eaters fill the trees. At night the air is filled with whippoorwills and other goatsuckers, gorging themselves on insects. By day, hawks and eagles are alert for live prey, while vultures soar about, watching for carrion. Woodpeckers hammer at the trees, and the streams swarm with water birds—ducks, geese, herons, egrets, spoonbills, ibises, and storks

Insects, Reptiles, and Fish

Few regions have so many and such gorgeous insects In the neighborhood of Belém (Pará) twice as many kinds of moths and butterflies are found as in all Europe. Fireflies light the night with red, yellow, and green flashes; cicadas maintain a constant din. The ground and plants are alive with destructive ants, cockroaches, and termites. Flies, gnats, and ticks make life miserable for man; and mosquitoes infect him with malaria and yellow fever. Beetles are headed by the *Titanus giganteus*, which is 5 or 6 inches long. Hornets, wasps, and stingless bees are common.

Lizards flick about everywhere. Other common reptiles are constrictor and poisonous snakes, water snakes, turtles, and alligators. The tartaruga turtle is a native mainstay for food. The Indians also eat the deadly bushmaster, a snake similar to the rattlesnake.

Fish of perhaps 2,000 species fill the waters. The most dangerous are electric eels and the flesh-eating piranha. A school of these small fish will in a few moments devour the largest animal that may venture into the water where they lurk, provided only that a scratch or wound first gives them a taste of blood. The huge-mouthed *pirarucu* or *arapaima* is the principal food fish. Some specimens are 15 feet long and weigh 500 pounds.

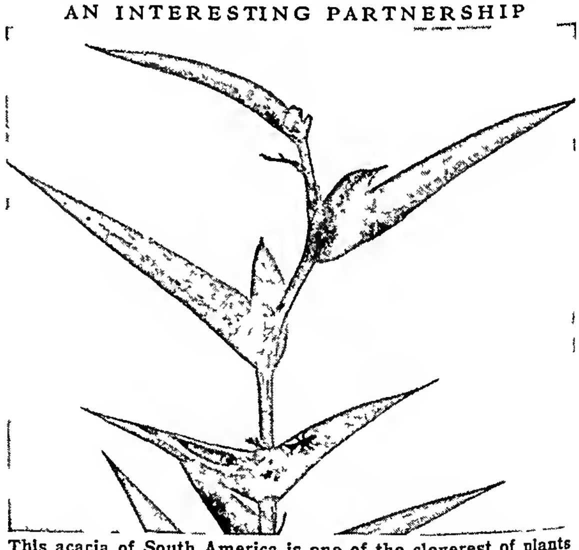
"Living Fossils" and Other Strange Animals

The protection of the tropical forest has enabled many strange and primitive types of animal to survive. Among birds is the hoatzin or ama, with claws on its wings like those of the fossil *Archaeopteryx*. Both giant and pigmy armadillos are found. Several species of ant-eaters find rich living, and their relatives the sloths have taken to the trees. A queer-looking cow-faced mammal, the manatee or sea-cow, lives in shallow coastal waters and in the rivers. The Indians hunt it for its porklike flesh. Opossums range from the size of mice to the size of a cat. Among the swarming bats are blood-sucking vampires. The tarantula spiders are large enough to hunt birds.

Life in Other Equatorial Rain Forests

As the slopes of the Andes rise from the western margin of the Amazon basin, palms gradually disappear and other types of vegetation take their place Among these are giant ferns, and the cinchona trees which once furnished the world supply of quinine but are now scarce. On the Pacific coast of Ecuador and Colombia, the narrow strip of equatorial rain forest contains the tagua or ivory-nut palm, the toquilla palm, the castilloa tree, and the silk-cotton or kapok tree. Here too is the balsa tree, which furnishes a tough wood far lighter than cork.

AN INTERESTING PARTNERSHIP



This acacia of South America is one of the cleverest of plants In its hollow thorns it provides a home for certain flesh-eating ants, which serve as the plant's guardians, driving away all leaf-cutting ants which might injure the acacia.

To the north and east, the Caribbean forests of Colombia and Venezuela have many fine furniture and specialty woods. Among the products of the Guiana forest in the extreme northeast are balata and several kinds of valuable cabinet woods that await develop-

THREE-TOED SLOTH, CHAMPION OF SLOW MOTION

Natives of the Amazon forest call this animal the "ai" from its sharp cry. Like the others of the family, this mother and baby spend all their time among the branches of trees, crawling upside down with unbelievable slowness in search of the leaves they feed on.

ment in world markets. (*See also* Amazon River; Brazil; and Fact-Index entries on the principal plants and animals.)

The Tropical and Subtropical Savannas

North and south of the Amazon rain forest are the tropical and subtropical grasslands called savannas. These are the *llanos* of Venezuela, the *campos* of Brazil, and the Gran Chaco of Bolivia, Paraguay, and Argentina. In the rainy season the grass grows to the height of a man. Here and there are thorny shrubs and low trees. One of the palms, the carnauba or wax palm of the Brazilian Highlands, is commercially important. The wax from its leaves resembles beeswax, and is exported for use in electric insulation and for other purposes. In the semiarid northeastern part of the Brazilian Highlands, grass gives way to a dreary tangle of cacti, acacias, and other thorny shrubs (*caatinga*). In southeastern Brazil are forests of Paraná pine and a holly bush which yields *yerba maté*. The Paraná pine, or araucaria, is the continent's most important softwood, and *yerba maté* its characteristic beverage. The latter is also abundant in the Chaco, along with quebracho trees and palms.

Animal life consists generally of the hardier tropical species, such as ant-eaters, tapirs, and armadillos; with some running animals, such as deer. The huge running bird, the rhea, can also be found in the open spaces of Paraguay, and occasionally in western Brazil and outlying parts of Uruguay and Argentina.

Wild Life of the Pampa

On the Pampa, the comparative dryness confines the native plant life to grasses, except on the margin. Near the Paraná, the evergreen *ombu* provides a welcome shade. In the north and northeast is a straggling fringe of subtropical trees and bushes. But the sycamore, the eucalyptus, and other trees do well when men plant them for shade and windbreaks. Patagonia too is predominantly grassland.

Hares, deer, armadillos, foxes, and skunks are common. The puma and the guanaco, once abundant, are now scarce. The birds include hawks, owls, partridges, plovers, and the rhea. Near the rivers live ducks, geese, herons, and storks. The rivers support trout, salmon, eels, and an excellent food fish called the *pejerrey*.

On the High Mountains and Islands

Throughout the length of the Andes, the lower slopes share the life of the adjoining lowland. At greater elevations, the life gradually changes until on the cold, windswept heights only the hardiest of ground

A LLAMA FIGHTS FOR HER YOUNG

This mother llama is expressing her resentment by spitting at the laughing herdsman. Llamas have been domesticated since long before the Spanish conquest. But they are stubborn, and it takes an experienced handler to get them to do their work.

growths survive. On the high plateaus, mosses, lichens, and the tough *ichu* grass are the principal plants. In Peru and Bolivia the resinous, mosslike *yareta* and the bushy evergreen *tola* supply fuel. The *totora* reeds of Lake Titicaca are woven into boats called balsas. The most important native animals are llamas, alpacas, vicuñas, and guanacos of the camel family; and a fur-bearing rodent, the chinchilla. Birds include ducks and other game birds; the meat-eating hawks, eagles, buzzards, and majestic condors. Sheep and goats live wherever men have introduced them.

Some of the islands off the coasts offer splendid havens for birds and, when moist enough, for plant life. The Galápagos Islands, 600 miles from Ecuador, have a remarkable array of animal species found nowhere else. They are especially famous for their giant tortoises.

The Lobo, Chincha, and other small islands off the Peruvian coast are all but covered with the nests of fishing birds—cormorants, gulls, boobies, pelicans, and many others. Through the centuries, the droppings (guano) of these birds covered the islands to a depth of from 40 to 150 feet. This guano is the richest nitrogenous fertilizer known. During the 19th century most of it was stripped away and future supplies were endangered. The Peruvian government now keeps each of the islands closed in turn, and protects the birds.

Along the coast of Chile the cold Humboldt Current attracts Antarctic birds and seals. On much of Tierra del Fuego and the Falkland Islands, where the constant wind hinders tree growth, the land is covered with tussock grass six or seven feet high.

Four and a Half Centuries of Eventful History

SOUTH AMERICA was discovered by Christopher Columbus in 1498. That year Columbus, on his third voyage to the New World, touched the continent at the mouth of the Orinoco River. Other navigators soon followed. In 1499 Alonzo de Ojeda, also in the service of Spain, explored most of the eastern coast north of the mouth of the Amazon River. He was accompanied by Americus Vespucius, whose name was given to the continent (*see* Vespucius, Americus). In separate expeditions the following year Vicente Pinzón, for Spain, and Pedro Alvares Cabral, for Portugal, sighted the coast of Brazil. By 1520, when Magellan sailed triumphantly into the Pacific, the entire Atlantic coast of South America had been explored. (*See also* America.)

With exploration came conquest and settlement. By the Treaty of Tordesillas (1494), Spain and Portugal had divided the New World between them. Portugal received the eastern part of the continent to a line that roughly coincides with the 50th meridian; Spain received the rest. Lured by the promise of fabulous wealth, Spanish and Portuguese adventurers braved all dangers to win riches in their new lands. In 1509, more than a century before the Pilgrims set foot in Plymouth, Ojeda established a colony on the north coast of Colombia. Pizarro, bold and ruthless, wrested Peru from the Incas in 1533 (*see* Incas; Pizarro, Francisco). Another Spaniard, Francisco de Orellana, spanned the continent in 1541, crossing the Andes and following the Amazon to the Atlantic. By the end of the 16th century, most of the great South American cities had been founded.

Colonial Life and Government

For two centuries, all of Spain's territory in South America, except Venezuela, was included in a single unit called the viceroyalty of Peru. But, because administration of so vast an area proved difficult, other viceroyalties were created in the 18th century. Then the viceroyalty of New Granada comprised the northern part of the continent; the viceroyalty of Peru, most of the western coast; and the viceroyalty of La Plata, the central and southern part.

The Spanish colonies were ruled from Spain by the Council of the Indies, set up at Seville in 1524. In the colonies, the viceroy exercised supreme power and often dominated the *audiencia*, the advisory council and supreme court of the viceroyalty. The important unit of social and economic life was the *encomienda*, one or more Indian villages governed by a Spaniard. The proprietor (*encomendero*) ruled the Indians almost as serfs, but was responsible for their education and religious instruction. The *encomienda* was abolished late in the 18th century, but the great estates of today are a survival of the system.

Colonial commerce, traffic, and immigration were controlled from Spain by the *Casa de Contratación* (House of Trade) until 1790. Trade was rigidly regulated for the benefit of the mother country, and non-Spanish immigrants were excluded.

For about three centuries, mining was the chief occupation of the Spanish colonies, except around the Rio de la Plata. Agriculture supplied little more than local needs. The Spanish king enjoyed huge revenues from the colonies by exacting his "royal fifth" of all the precious minerals discovered or mined; by exercising monopolies; and by taxing sales.

Portugal's colonial government was at first less centralized than Spain's. The king of Portugal divided Brazil into "captaincies," governed by landed proprietors who had almost absolute authority. In the latter half of the 18th century, however, the governor general, responsible directly to the king, assumed almost complete power. Taxes were heavy, and trade was rigidly controlled by the home government. The Portuguese, who settled the land and developed farms, were on the whole better colonists than the Spaniards, who tried mainly to win sudden fortunes from mining. But the development of large plantations, which became the chief units of social life, fastened upon Brazil until 1888 the evils of Negro slavery.

The Colonies Win Independence

By the close of the 18th century, revolution was brewing in the Spanish colonies. The *criollos* (creoles), as the colonial-born whites were called, grew to hate the *peninsulares*, the officials sent out from Spain, for monopolizing the important and well-paid

REGIONS THAT CHALLENGE DEVELOPMENT

This tangle of tropical rain forest along the Amazon River shows why so little of the vast valley is inhabited by civilized men. Matted bushes and trees grow so thick that men must chop their way through them. Malaria is widespread.

The Kaieteur Falls of the Potaro River in British Guiana (left) are four and a half times as high as Niagara. Here, in the midst of tropical forest, they plunge 740 feet, offering the possibility of eventual development for hydroelectric power.

offices. The *peninsulares,* by refusing to make concessions to the creoles, forced them into an alliance with the mestizos. Thus was born a strong colonial group demanding the right to govern itself. This demand was intensified by the fact that the high taxes and troublesome trade restrictions of the mother country drained off the wealth of the colonies and stifled enterprise. Furthermore, the success of the American and the French revolutions inflamed the young creoles, many of whom were well versed in the political and social doctrines emerging in the 18th century.

The Napoleonic wars in Europe set the stage for revolt in South America. Beginning in 1808, when Napoleon placed his brother Joseph Bonaparte on the throne of Spain, the colonies took advantage of the situation to set up their own governing bodies called *juntas.* In 1811 Venezuela, under the leadership of Francisco de Miranda, declared its independence, and other colonies soon followed its lead. In 1812, however, the new republic organized by Miranda was overthrown, and its leader was sent to Spain, where he died in prison.

In 1817 the revolution moved toward a successful conclusion with the start of military campaigns by the great leaders, Gen. Simón Bolívar, in the north, and Gen. José de San Martín, in the south. Aided by Gen. Bernardo O'Higgins, San Martín freed Chile from the royalists by 1818, and by 1822 he had liberated southern Peru. Bolívar freed Venezuela from Spain in 1821, and then with the help of his general, Antonio José de Sucre, went on to free the other Spanish-dominated countries in the north. With the fall of Callao in 1826, South America's struggle for liberation from Spain was won, less than 15 years after Venezuela had declared its independence. The entire continent was free from European rule, except for the Guianas, which Spain had lost to England, France, and Holland in the 17th century. Brazil had declared its independence in 1822, and thenceforth was a constitutional monarchy until 1889, when it became a republic. Thus ten new nations were born: Argentina, Uruguay, Paraguay, and Bolivia arose out of the old viceroyalty of La Plata; Colombia, Venezuela, and Ecuador, out of the viceroyalty of New Granada; and Chile and Peru, out of the viceroyalty of Peru.

Problems of the Young Nations

After winning their struggle for freedom, the new American nations faced the immense problem of governing themselves. Inspired by the ideals of the French and the American revolutions they adopted a republican form of government. They generally

accorded greater power to the president than did the United States, however.

After centuries of colonial subjection, the young republics were ill-prepared for democracy. Economic life was semifeudal with little manufacturing or foreign trade. Bitter antagonism existed between the Conservative landowners and the Liberals who sought industrial progress and social reform.

These conditions gave rise to periodic revolutions and encouraged dictatorship. Strong men, called *caudillos*, frequently led their followers in armed seizure of power. They abolished all opposition and ruled by stern and dictatorial methods. So typical and widespread were the *caudillos* that the 19th century has been called the "age of dictators."

The vaguely defined boundaries were the subject of conflicting territorial claims. Over such disputes, irresponsible leaders sometimes plunged their nations into war. Two devastating conflicts were the Paraguayan War (1865–70), in which Brazil, Argentina, and Uruguay conquered Paraguay; and the War of the Pacific (1879–84), in which Chile defeated Peru and Bolivia. On the whole, however, the South American nations have been outstanding in settling their disputes by peaceful means.

Even as the nations were being rocked by wars and revolutions, there began to emerge a more stable and democratic order. A decisive factor was the opening up of the continent to foreign capital and immigration. After the middle of the 19th century, British and American investors spent billions of dollars in developing its vast resources. Millions of immigrants poured in from all parts of Europe.

THE GREAT WALL OF PERU

The fortified Great Wall of Peru lies across the rugged mountains of the north. Both the origin and the purpose of the great prehistoric structure are unknown.

Forms of Government and Recent History

The constitutions of most South American countries closely reflect the United States constitution. Most of the ten republics have a centralized government, however, on the model of France. Argentina, Brazil, and Venezuela have a federal system; as in the United States, the national government exercises only those powers given it by the constitution, the remaining powers being reserved for the states. In all but one of the republics the chief executive is a popularly elected president; in Uruguay an executive council exercises these powers. The constitutions generally provide for a Senate and a Chamber of Deputies. Ecuador alone has a unicameral (single house) legislature. Voting qualifications vary widely in South America. More than half the countries give women the vote, and in Argentina and Peru voting is compulsory for qualified citizens.

In the first World War Brazil was the only South American nation to declare war on Germany. After the war all ten republics joined the League of Nations. The entire continent enjoyed a rapid expansion of trade as a result of the wartime demands for raw materials and foodstuffs. Postwar prosperity collapsed, however, in the world depression beginning in 1929. Economic difficulties revived civil strife. But the republics joined the movement, begun in 1933, to strengthen hemisphere solidarity. After the United States entered the second World War, all except Argentina quickly broke relations with the Axis and aided the Allies. In 1942 Brazil became the first to enter the war. Later all did, and in 1945 they joined the United Nations. After the war all South America took part in Inter-American conferences. (For details of these conferences, *see* Latin America.)

United States Aid and Hemisphere Defense

As ties strengthened between South America and the United States, the southern continent looked more and more to the United States for help in developing its resources. The Institute of Inter-American Affairs, incorporated in 1947, co-operated with Latin nations in providing technical assistance for agriculture, health, education, and other development projects.

In the 1950's Point Four funds supported this work. Several nations signed military aid pacts with the United States under its Military Security Act. Intrahemispheric relations were favorable and United States trade and private investments grew. In some republics, however, nationalist parties infiltrated by Communists charged "Yankee imperialism."

(For further information about the people of South America, their history, and culture, *see* Latin America; Latin American Literature. For geography, industries, and trade, *see* articles on the various countries.)

REFERENCE-OUTLINE FOR STUDY OF SOUTH AMERICA

I. Location and size S-248, list S-247: location in world, map W-204; relation to other continents, map S-249; political divisions, map S-252-3; air distances, polar projection map A-531

II. Structure of the land S-248-9, 250, 258, list S-247, map S-256, pictures S-271, 272, 277, 278
  A. Mountains and highlands S-248, 250, 269-70, 271-2, list S-247, map S-256
    1. Andes A-244-5, S-269-70: Aconcagua A-10
    2. Brazilian highlands B-287-8, S-271-2
    3. Guiana highlands G-222*d*, 223, S-270
    4. Patagonian plateau A-333, P-96, S-272
  B. Lowlands S-250, 269-70, list S-247, map S-256; Amazon basin A-184-6, S-270-1; Orinoco basin O-424*d*, S-270; Paraguay-Paraná plains S-272
  C. Rivers S-250, 258, 264, 270-1, map S-256: Amazon A-184-6; Orinoco O-424*d*; Plata P-314
  D. Coast line and islands S-248, 258, 269-70, list S-247: Cape Horn, picture S-272; Easter Island E-200; Falkland Islands F-15; Galápagos Islands G-3-5, picture S-258; Trinidad and Tobago T-189-90
  E. How the continent took shape through the ages G-54, 60, M-439: Andes A-244; Ice Age I-6

III. Climate S-258-61, 269-72, A-244-5: rainfall, temperatures, and winds, maps S-255, 257

IV. Plants and animals S-273-6, pictograph S-246: alpaca A-176; llama L-285, picture S-275

V. Natural resources S-248, 267, 270, 273, A-244, J-349, list S-247, pictograph S-246, picture S-269: land use and soil S-231, 272, pictograph S-246

VI. People S-247, 249, 264, L-109, 110-11, pictures S-250, 275: Indians S-249-50, 261-4, I-109-10, L-109-10, 111-12, pictures S-250, 259, 260, 261, 262
  A. Population distribution S-248, 250, 261, maps P-371, S-256
  B. Food S-262, 263, pictures S-250, 273
  C. Clothing S-261-2, 263, 264, pictures S-259, 260
  D. Shelter S-247, 261, 262-3, pictures S-259, 260, L-115

VII. Industries S-266-9, L-119, list S-247, pictograph S-246
  A. Agriculture S-262, 266-7, 270, 272, A-184
  B. Animal products S-273: alpaca A-176; llama L-285
  C. Forest products S-267, 273, 274-5
  D. Mining S-267: copper C-473; petroleum, picture S-267; tin, picture L-119
  E. Manufacturing S-268, 272, L-119, list S-247

VIII. Trade, transportation, and communication S-264-9, A-184-6, A-244, L-118, O-424*d*, P-314, picture L-108: exports and imports, list S-247. See also in Fact-Index Trade, table

IX. Education and the arts L-107, 115-18: literature L-124-9: Latin American libraries L-203-4

X. Governments of the republics S-278

XI. History S-276-8, L-112-14: relations between the American republics L-120-3. See also in Fact-Index South America, *subhead* history

POLITICAL DIVISIONS

Republics: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela
Colony: British Guiana
Overseas department: French Guiana
Overseas territory: Surinam (Dutch Guiana)

I. Argentina A-330-8, maps A-331, S-253
  A. Land structure and climate A-330-1, 332, map A-331, pictures A-333, S-271
    1. Pampa, Chaco, and Mesopotamia A-330-1, 332-3, S-272: Plata River P-314
    2. Andean region and Patagonia A-333, P-96, S-272
  B. People A-331-2, 333-4, L-110, 111, pictures A-337, S-264, map S-256
  C. Resources and industries A-331, 332, 333, 334-6, L-119, list A-330: flax F-142; meat industry A-334-5, C-141*b*, M-156; wheat W-117
  D. Trade, transportation, and communication A-334-5, 336, B-339-41, P-314, list A-330: air transport, picture L-108. See also in Fact-Index Trade, table
  E. Principal cities A-334, list A-330: Buenos Aires B-339-41, pictures A-334, 335
  F. Education, religion, and the arts A-336-7, L-116: literature L-125-6
  G. History and government A-337-8, L-114, 122, U-407, S-43

II. Bolivia B-222-4, maps B-288, S-252-3
  A. Land structure and climate B-222-222*a*, list B-222*a*: Lake Titicaca, picture B-222*b*
  B. People B-222*b*, S-263-4, map S-256, pictures B-222*a*, *b*, 223: food B-223; clothing B-223; shelter B-223, picture B-222*b*
  C. Resources and industries B-222*a*-*b*, 224, list B-222*a*: alpaca A-176; bismuth B-198; nitrates N-239; tin, pictures L-119, B-222*a*
  D. Trade and transportation B-224, picture B-222*b*
  E. Principal cities B-224, list B-222*a*: La Paz L-101, picture B-222
  F. Education, religion, and art B-223-4, L-126
  G. History and government B-224, C-256

III. Brazil B-287-94, maps B-288, S-252-3: area compared to United States, chart U-246
  A. Land structure and climate B-287-8, 289, S-270-2, map B-288: Amazon River A-184-6
  B. People B-289, 290-1, L-110, 111, map S-256, pictures B-287, 289-90, S-260, 261, M-430
  C. Resources and industries B-291, 292, 294, S-43*b*, list B-287: coffee C-378-9, 380, B-290, picture C-377; diamonds D-78, 81, B-291; manganese, picture S-268
  D. Trade, transportation, and communication B-292-3, A-184-6, R-154-5, picture L-106
  E. Principal cities B-291, 292, list B-287: Rio de Janeiro R-154-5, picture L-106; São Paulo S-43*b*
  F. Education and art B-293, L-115, 116, P-37*a*, color picture P-37*a*: literature L-126
  G. History and government B-293-4, S-276, A-188, 191, P-381

IV. Chile C-249-56, maps C-250, S-252-3
  A. Land structure and climate C-249-51, 252, 253, map C-250: Andes A-244-5 (Aconcagua A-10); Mount Osorno, picture S-248; Cape Horn, picture S-272

B. People C-251, 255-6, map S-256, picture C-254
C. Resources and industries C-251-4, M-265, V-435, list C-249: copper C-252, C-473, 474; iron C-252; nitrates C-251, F-55, N-239, N-241
D. Trade, transportation, and communication C-254, S-43*b*, V-435, pictures L-108, S-247
E. Principal cities C-254-5, list C-249: Santiago S-43*b*, picture C-252; Valparaiso V-435, picture S-247
F. Education and art C-256: literature L-126, 124
G. History and government C-256, I-50, A-337, P-164-5, picture A-295: Bernardo O'Higgins O-346; San Martín S-42

V. Colombia C-387-9, maps C-387, S-252
A. Land structure and climate C-387-8, B-220, S-269-70, map C-387, picture C-389: Andes A-244
B. People C-388, map S-256, pictures C-389
C. Resources and industries C-388, B-220: coffee C-378, 379, 380; emeralds J-349; petroleum P-169; platinum P-315
D. Trade, transportation, and communication C-387-8, B-220: Magdalena River, picture S-265
E. Principal cities C-388: Bogotá B-220
F. Education and art C-388, 389: literature, L-126
G. History and government C-388-9, B-222, P-52, R-222, L-122

VI. Ecuador E-230-2, maps S-252, P-164
A. Land structure and climate E-230-1, S-270, map P-164: Galápagos Islands G-3, pictures G-4, S-258
B. People E-231, map S-256, pictures L-110, 111
C. Resources and industries E-231-2: Panama hats H-281
D. Trade and transportation E-231-2. See also in Fact-Index Trade, table
E. Principal cities E-232: Quito, picture E-231
F. Education and art E-232, L-116, L-127
G. History and government E-232, B-222, I-50

VII. Paraguay P-76-7, P-314, maps B-288, S-252-3: people P-77, map S-256, picture P-76; literature L-128; history P-76, 77, B-224, C-3

VIII. Peru P-161-5, maps P-164, S-252
A. Land structure and climate P-161-2, map P-164, pictures S-260, 278: Andes A-244
B. People P-164, map S-256, pictures P-161, 163, L-109, S-250, 260, 262: shelter, pictures S-260, L-115
C. Resources and industries P-162, 164: alpaca A-176; cochineal C-373; copper, picture P-163; cotton C-498; guano S-276, picture S-259; llama L-285, picture S-275; petroleum, picture S-267; quinine Q-14
D. Trade, transportation, and communication P-161, 162, 164, pictures P-161, T-170*b*. See also in Fact-Index Trade, table
E. Principal cities P-164: Lima L-243, pictures L-115, 121; Callao L-243
F. Education and art P-165, L-116: literature L-128; University of San Marcos library L-204
G. Government and religion P-165
H. History P-164-5, S-276: antiquities I-50, pictures A-301, S-263, T-104. See also in Fact-Index Peru, *subhead* history

IX. Uruguay U-406-8, maps U-407, S-253
A. Land structure and climate U-406, M-379, map U-407: Plata River P-314
B. People and cities U-406, 407: Montevideo M-379
C. Resources, industries, and trade U-406-7, M-379, P-314. See also in Fact-Index Trade, table
D. History, education, and art U-407-8, L-117: literature L-128-9

X. Venezuela V-440-4, maps V-442, S-252
A. Land structure and climate V-440-1, map V-442, picture V-443: Orinoco River O-424*d*
B. People and cities V-441-2, pictures V-443
C. Resources and industries V-440, 441, 442: petroleum V-442, P-169, picture V-444; asphalt A-424; iron I-238
D. Trade and transportation V-441, 442, pictures V-443: Orinoco River O-424*d*. See also in Fact-Index Trade, table
E. Government and religion V-442
F. History, education, and art V-442, 444, B-222, C-345, H-277, L-113: literature L-129

XI. Guiana—British, Dutch (Surinam), French G-222*d*-223, S-270, maps G-223, S-252: land structure, climate, and population, maps S-255, 256, 257

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(*See also* bibliography for Latin America.)

SOUTHAMPTON, ENGLAND. The city of Southampton has one of England's finest harbors. It lies on a peninsula at the head of Southampton Water, an inlet of the English Channel. The peninsula is formed by the Itchen River on the east and the Test River on the west. The old part of Southampton occupies the end of the peninsula and is fronted by the docks. It is divided from the modern part by the ruins of an old Saxon wall that traverses the center of the city. Three old gates still stand.

The entrance to Southampton Water is protected by the Isle of Wight (*see* Wight, Isle of). From around the western and eastern ends of the island the inlet receives two tides—from the Atlantic and from the Channel. Docking of large liners is made easy by the long periods of high, slack water caused by the tides.

Southampton vessels visit all parts of the world. Much of Great Britain's heavy overseas cargoes land or are loaded at Southampton. London is only 70 miles northeast, and sea passengers generally land or embark at Southampton. The principal industries are shipbuilding yards, breweries, and distilleries.

In ancient days a Roman walled town was built on the east bank of the Itchen. At the time of the Danish invasions, about the 11th century, the present west bank site became the more important. Old Roman and Saxon ruins still exist. Southampton's position—guarded from sea storms and enemy attacks by the Isle of Wight—and its great harbor have made it important. During the second World War, Southampton suffered heavily under German air attacks. Bombed buildings have been rebuilt or replaced, and in 1950 a new terminal dock was completed. Population (1951 census, preliminary), 178,326.

SOUTH BEND, IND. The industrial and commercial city of South Bend draws workers for its factories and customers for its stores from a wide surrounding area of villages and farms. Its factories produce automobiles and trucks, aviation and marine accessories, farm tools and equipment, sewing and washing machines, tools and dies, electrical goods, fishing tackle, paints and varnishes, and many other articles. Its large stores and wholesale houses serve the people of south central Michigan and north central Indiana.

South Bend lies four miles south of the Michigan border and 75 miles east of Chicago. It occupies both banks of the southernmost bend of the St. Joseph River (hence its name South Bend). The river pursues a winding northwesterly course through the city. South Bend's business district overlooks a dam from the river's west bank, and the industries occupy southern and western areas of the city.

The University of Notre Dame du Lac was established in 1842 by Father Sorin, of the Roman Catholic Brothers of the Congregation of the Holy Cross. The campus spreads over 1,700 acres and has two lakes and two golf courses. The university has collected notable art treasures and an excellent library. In an old courthouse in the city's center, the Northern Indiana Historical Society maintains a museum. The Studebaker Museum of Transportation has an interesting collection of horse-drawn and motor vehicles. The log cabin of the first settler is preserved in one of the city's parks.

A Miami Indian village once occupied the South Bend site. In the late 1600's this village was visited by both Father Marquette and La Salle. Pierre Navarre established a trading post here in 1820 for the American Fur Company. Early names given the settlement were Big St. Joseph Station, St. Joseph's, and Southold. In 1830 the Post Office Department gave the town its present name. South Bend's early industry was the usual frontier sawmills and gristmills. In 1852 two brothers, Henry and Clement Studebaker, opened a blacksmith and wagon shop and in time became prosperous manufacturers of horse-drawn vehicles. In the early 1900's their shops began to make automobiles, and today South Bend is one of the nation's major producers of cars and trucks.

South Bend is the seat of St. Joseph County. It was incorporated as a town in 1835 and chartered a city in 1865. The city government is the mayor-council form. (*See also* Indiana.) Population (1950 census), 115,911.

The "PALMETTO STATE" *Keystone of the* SOUTH

SOUTH CAROLINA. An abundance of palmettos has given South Carolina the nickname of the "Palmetto State." Perhaps just as fitting would be the one applied to Pennsylvania, the "Keystone State." Both in shape and in history, South Carolina has been a "keystone" of the South Atlantic seaboard.

The state is wedge shaped, with the base on the Atlantic coast and the tip thrust into the Appalachian Mountains. If all the states along the coast were thought of as forming an arch, South Carolina would make an excellent geographic keystone.

South Carolina has been a key state in history as well. Before the Revolution, it prospered as an English colony. During the war, the colony's defenders drove off an early naval attack, but later the British seized the region as a key position for regaining control of the South. Thereafter South Carolina suffered for its devotion to independence.

After the war, the state was among the leaders in using the newly invented cotton gin to build a great cotton trade. It pioneered in railroad development by placing in service the first American-built locomotive, the *Best Friend of Charleston*, in 1830.

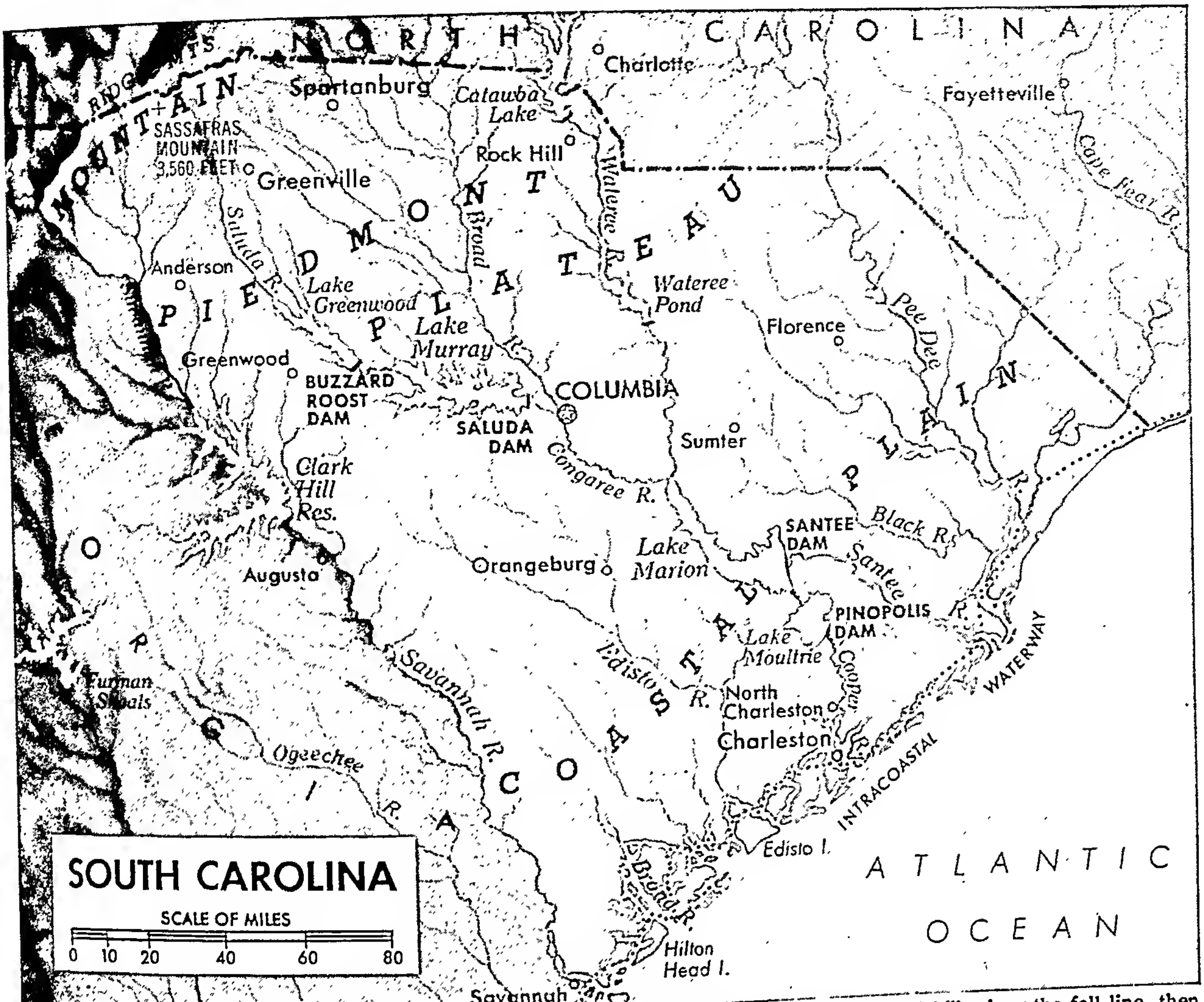
The state led the south in the series of events which resulted in the Civil War. In 1832 South Carolina's brilliant United States Senator John C. Calhoun led the Southern cause in the historic debate concerning nullification. Later South Carolina led the Southern states out of the Union and fired the shot against Fort Sumter which started the Civil War. Then came the difficult reconstruction period, and in more recent times a great industrial revolution, especially in the manufacture of textiles, and a rapid growth in cattle raising.

"Low Country" and "Up Country"

The map shows the land of South Carolina rising from its wide coastal plain by gradual steps through fertile alluvial plains, sandy highlands, and low mountains. The state is divided into two distinct natural regions. The fall line of the rivers separates it into "low country" and "up country."

In Cypress Gardens near Charleston, Spanish moss festoons the cypress trees, and low-lying palmettos skirt the water's edge.

"Low country" is the eastern two thirds of the state. It is part of the Atlantic Coastal Plain. Along the broken ocean shore are many bays and islands.



The fall line of rivers separates "low" from "up" country. The state rises from the coast to its northwest corner. The coastal plain gives way to a belt of sand hills along the fall line, then to the Piedmont Plateau and to the Blue Ridge Mountains.

The rest of the state is "up country." It includes part of the Piedmont Plateau and the Blue Ridge Mountains. Here is the highest point in the state, 3,560-foot Sassafras Mountain near Rocky Bottom.

Wealth from the Soil

Agriculture ranks next to manufacturing in number of people employed and in value of products. The Palmetto State is among the first six producers in the nation of cotton lint, cottonseed, tobacco, and peaches. Corn and oats are the state's principal grain crops. Winter wheat is also grown in some localities. For local use the state produces grain, truck crops, sweet potatoes, hogs, cattle, and milk. Its truck crops are also marketed in Northern cities.

Cotton is by far the most valuable cash crop. It is produced almost everywhere in the state. At one time the Sea Islands yielded a very fine long cotton fiber. About 1920 the boll weevil forced farmers to stop growing this variety, and many farmers turned from one-crop farming to varied agriculture. This helped increase farm income and save depleted soil.

Cotton Textiles the Largest Industry

South Carolina is among the first four states in textile manufacturing. This industry employs two out of three of the state's workers. The total value added to its textile products is about twice that added to all its other manufactures combined. Cotton fabrics make up much of the output, but South Carolina also leads all states in making rayon fabrics. An important related industry is making cotton clothing.

Industries in the state draw heavily on its natural resources. There is an abundance of electric power, both from dams on rivers and from steam plants. Thousands of miles of transmission lines connect generating stations with each other and with power plants in Georgia and North Carolina. Commercial forests spread over the state. About 900 million board feet of lumber is cut each year, much of it for the state's wood-products industries. Southern pine abounds in the coastal region, cypress is found in the swamps, and hardwoods on the hillsides in the Piedmont section. There are large plants making paper at Charleston, Georgetown, and Hartsville. Coast fishing is of some importance. In addition to the sale of fresh fish, thousands of cases of oysters and crabs are canned annually.

South Carolina has few minerals, but those few are found in abundance. Clays and stone are the chief

minerals in value. The principal clay in the state is kaolin, or china clay. It is used for filling and coating paper and for making rubber, pottery, stoneware, and high-grade tile. South Carolina mines about a fifth of the nation's kaolin output. Granite is the most common stone. Cement is also important.

Cities of the Palmetto State

The largest city and capital of South Carolina is Columbia. In almost the exact center of the state, on the Congaree River, it is an industrial and agricultural center (*see* Columbia). Historic Charleston occupies a narrow peninsula between the Cooper and Ashley rivers. It is a leading commercial center and the state's top-ranking seaport (*see* Charleston).

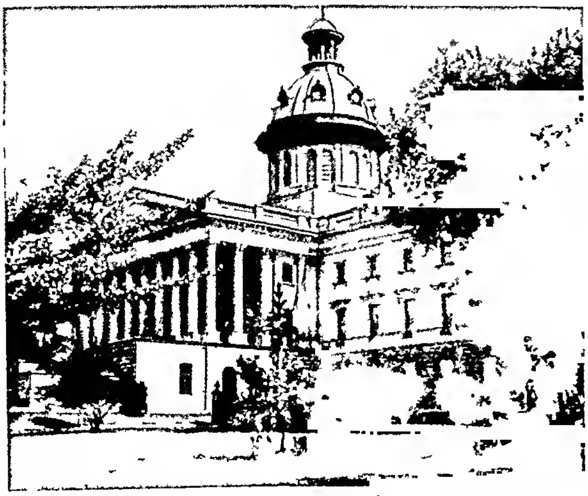
Greenville and Spartanburg, at the foot of the Blue Ridge Mountains, are thriving textile-manufacturing cities. They stand in some of the finest cotton country and general farmlands of the state. Greenville also manufactures textile machinery, leather belting, clothing, and other products. Spartanburg, about 30 miles to the southwest, is in the middle of South Carolina's tremendous peach-growing region.

Rock Hill is also a textile-manufacturing center in a rich farm area of northwestern South Carolina. Here is Winthrop College, state college for women. A large railroad center is Florence, serving the northeast part of the state and the Atlantic coast.

Early Government Was of Feudal Type

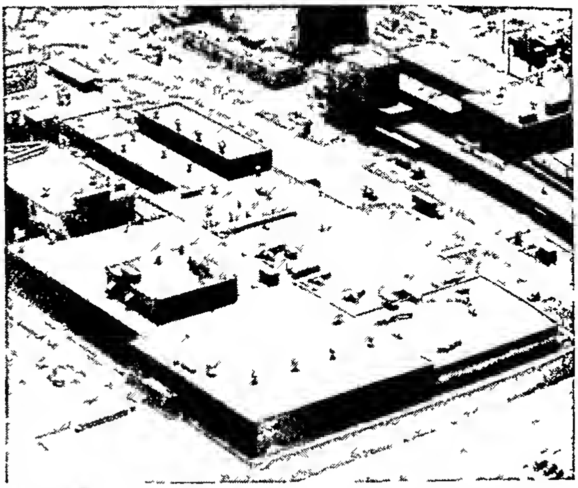
The first settlement attempted in South Carolina was by a Spaniard, De Ayllón, in 1526. It was shortly abandoned. In 1562, a group of French Protestants, headed by Jean Ribaut, set up an early colony on Parris Island, but this settlement was soon deserted. In 1663 Charles II of England made over to eight of his lords and gentlemen the province of "Carolina." Two years later this vast tract was defined to include the whole of the present Carolinas, Georgia, and much of Florida and extended east and west "from sea to sea."

THE STATE CAPITOL AT COLUMBIA



Light-gray granite walls, handsome porticos, and the comparatively small green dome in the style of the Italian Renaissance give the Statehouse an air of unusual grace and dignity.

THE STATE'S INDUSTRIAL GROWTH



South Carolina has had a part in the rapid industrial expansion of the South. This plant at Camden is the world's first full-scale commercial plant for producing orlon, a synthetic fiber.

Among these "proprietaries" were the Earl of Clarendon and Sir Anthony Ashley Cooper (later made Earl of Shaftesbury), for whom the Ashley and Cooper rivers were named. In 1669 this proprietary board adopted for the colony a system of government based on feudal principles and drawn up by the philosopher John Locke. Though greatly modified in operation, this constitution encouraged the plantation system and a slaveholding aristocracy.

The first permanent English settlement, established in 1670 on the west bank of the Ashley River, was named Charles Town, in honor of Charles II. In 1680 it was moved to the east bank between the Ashley and Cooper rivers. After the Revolution, its name was changed to Charleston. The colony prospered through trading with the Indians and shipping—principally furs and skins to England and grain to the West Indies. Later Carolina planters grew vast crops of rice and indigo on the plantations lining the rich river valleys of the "low country."

Battles Between English and Spanish

The Spaniards in Florida, who had held a fort on Parris Island from 1566 to 1587, incited the neighboring Indians to war on the English colonists in 1671–72. Lord Cardross, a nobleman in search of religious freedom, established a Scottish settlement, Stuart Town, at Port Royal in 1684. Spaniards from St. Augustine descended suddenly upon Stuart Town in 1686, killed many of the Scottish settlers, and burned nearby plantations owned by English colonists. South Carolina colonists sought revenge by attacking St. Augustine in 1702 but were beaten back. In 1706 a combined French and Spanish fleet arrived and demanded Charles Town's surrender, but Col. William Rhett armed some merchant vessels and drove it away. In 1718 Rhett defeated the pirate fleets that had been preying upon Carolina ships.

The colonists often clashed with the proprietors and their governors. Some refused to help fight the powerful Yamasee Indians, who were defeated

Continued on page 294

South Carolina Fact Summary

SOUTH CAROLINA (S.C.): Named in honor of Charles I (Latin, *Carolus*), king of England.

Nickname: "Palmetto State," from palmettos which grow along the coast.

Seal: In left oval, a palmetto tree on seashore, 12 spears bound and crossed upon stem; below, 1st motto; in right oval, a woman walks on seashore over swords and daggers, holding laurel branch; above, 2d motto.

Mottoes: First motto, Animis Opibusque Parati (Prepared in Minds and Resources); the second, Dum Spiro, Spero (While I Breathe, I Hope).

Flag: For description and illustration, *see* Flags.

Flower: Carolina yellow jessamine. **Bird:** Carolina wren. **Tree:** Palmetto. **Song:** 'Carolina'—words, Henry Timrod; music, Anne Curtis Burgess.

THE GOVERNMENT

Capital: Columbia (since 1786).

Representation in Congress: Senate, 2; House of Representatives, 6. Electoral votes, 8.

General Assembly: Senators, 46; term, 4 years. Representatives, 124; term, 2 years. Convenes on the second Tuesday in January every year. No limit to length of session.

Constitution: Adopted 1895. Proposed amendment must be (a) passed by a two-thirds majority of both legislative houses and (b) ratified by majority voting on amendment at a popular election and by a majority of next General Assembly.

Governor: Term, 4 years. May not succeed himself.

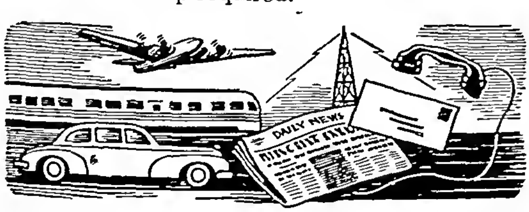
Other Executive Officers: Lieutenant governor, secretary of state, attorney general, treasurer, comptroller general, adjutant general, all elected; terms, 4 years.

Judiciary: Supreme court—5 justices, elected at large; term, 10 years. District courts—14; judges' terms, 4 years. Probate courts—1 in each county; term, 4 years. General Assembly chooses district and probate judges.

County: 46 counties, each administered by a sheriff, clerk of court, supervisor, auditor, treasurer, coroner; all elected; terms, 4 years.

Municipal: Mayor and council form most common.

Voting Qualifications: Age, 21; residence in state, 2 years; in county, 6 mos.; in district, 4 mos.; literacy test or property ownership required.



TRANSPORTATION AND COMMUNICATION

Transportation: Railroads, 3,200 miles. First railroad, South Carolina Railroad, 1830 (completed Charleston to Hamburg, 1833). Rural roads, 47,500 miles. Airports, 64.

Communication: Periodicals, 29. Newspapers, 95. First newspaper, *South Carolina Gazette*, Charleston, 1732. Radio stations (AM and FM), 54; first station, WSPA, Spartanburg, licensed Nov. 1929. Television stations, 2; first station, WCOS-TV, Columbia, began operation May 1, 1953. Telephones, 326,100. Post offices, 491.

THE PEOPLE AND THEIR LAND

Population (1950 census): 2,117,027 (rank among 48 states—27th); urban, 36.7%; rural, 63.3%. Density: 69.9 persons per square mile (rank—18th state).

Extent: Area, 31,055 square miles, including 750 square miles of water surface (39th state in size).

Elevation: Highest, Sassafras Mountain (near Rocky Bottom), 3,560 feet; lowest, sea level.

Temperature (°F.): Average—annual, 63°; winter, 47°; spring, 63°; summer, 79°; fall, 64°. Lowest recorded, —13° (near Longcreek, Jan. 26, 1940); highest recorded, 111° (Calhoun Falls, Sept. 8, 1925, and other locations and earlier dates).

Precipitation: Average (inches)—annual, 47; winter, 11; spring, 11; summer, 16; fall, 9. Varies from about 44 in central part to about 76 in northwest.

Natural Features: Wide coastal plain, known as the "low country," with sandy soil and swampland. Plain rises to the fall line of the rivers. Beyond the fall line lies the "up country," made up of hilly Piedmont Plateau and, in the northwest, Blue Ridge Mountains. Principal rivers: Edisto, Pee Dee, Santee, and Savannah.

Land Use: Cropland, 25%; nonforested pasture, 5%; forest, 57%; other (roads, parks, game refuges, wasteland, cities, etc.), 13%.

Natural Resources: *Agricultural*—mild climate and long growing seasons. *Industrial*—forests supply naval stores, lumber, and other wood products; deposits of clay for making pottery; stone quarries; sand and gravel beds; streams for hydroelectric power. *Commercial*—scenic areas attract tourists.

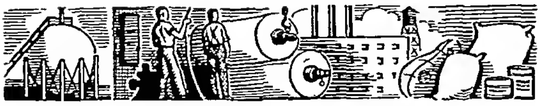
OCCUPATIONS AND PRODUCTS

What the People Do to Earn a Living

Major Industries and Occupations, 1950

Fields of Employment	Number Employed	Percentage of Total Employed
Manufacturing	210,779	27.8
Agriculture, forestry, and fishery	198,268	26.2
Wholesale and retail trade	101,965	13.5
Personal services (hotel, domestic, laundering, etc.)	65,158	8.6
Professional services (medical, legal, educational, etc.)	48,916	6.5
Construction	41,966	5.6
Transportation, communication, and other public utilities	29,545	3.9
Government	18,623	2.5
Finance, insurance, and real estate	13,361	1.8
Business and repair services	11,109	1.5
Amusement, recreation, and related services	3,962	0.5
Mining	1,135	0.2
Workers not accounted for	10,591	1.4
Total employed	755,378	100.0

South Carolina Fact Summary



What the People Produce

A. Manufactured Goods (Rank among states—27th)
Value added by manufacture* (1952), $922,605,000

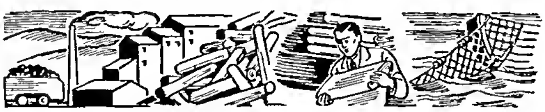
Leading Industries in 1947 (with Principal Products)	Value Added by Manufacture	Rank among States
TEXTILE MILL PRODUCTS......... Cotton and rayon broad-woven fabrics; finishing textiles	$558,680,000	4
LUMBER AND PRODUCTS........... Sawmills and planing mills; plywood plants	59,369,000	15
APPAREL AND RELATED PRODUCTS.. Men's dress shirts and nightwear; house furnishings	38,292,000	18
PAPER AND ALLIED PRODUCTS... Pulp, paper, and paperboard mills	36,879,000	22
FOOD AND KINDRED PRODUCTS .. . Bakery products; soft drinks; manufactured ice; meat products	33,928,000	36
CHEMICALS AND ALLIED PRODUCTS	16,595,000	30

*For explanation of value added by manufacture *see* Census

B Farm Products (Rank among states—32d)
Total cash income (1952), $387,759,000

Products	Amount Produced (10-Year Average)	Rank within State*	Rank among States†
Cotton lint.....	707,000 bales	1	6
Tobacco........	121,759,000 lbs.	2	5
Corn...........	26,067,000 bu.	3	23
Milk...........	274,000,000 qts.	4	40
Hogs...........	168,170,000 lbs.	5	25
Cottonseed.....	287,000 tons	6	6
Oats...........	16,012,000 bu.	7	17
Hay	454,000 tons	8	42

*Rank in dollar value †Rank in units produced



C. Fish (Rank among states—20th)
(Marine waters and coastal rivers, 1950), catch, 14,727,000 lbs.; value, $2,810,000

D. Lumber (Rank among states—12th)
900,000,000 board feet (5-year average)

E. Minerals (Fuels, Metals, and Stone)
Annual value (1951), $11,284,000
Rank among states—42d

Minerals (1951)	Amount Produced	Value
Clays	902,000 tons	$4,689,000
Stone	2,829,000 tons	3,690,000

F. Trade

Trade (1948)	Sales	Rank among States
Wholesale.. ..	$1,011,118,000	32
Retail..... ..	1,148,179,000	32
Service... ...	81,831,000	32

EDUCATION

Public Schools: Elementary, 2,444; secondary, 428. Compulsory school age, 7 through 16. State Board of Education composed of governor and state supt. of education, who serve ex officio, and 7 members, one from each of the 6 congressional districts and one "at large," appointed by governor, 4-year terms. State supt. of education elected, 4-year term. County boards of education consist of 7 or more members (less only by special legislation), appointed, 4-year terms. County supts. of education, some elected and some appointed, 4-year terms. City boards of education, number of members varies, some elected and some appointed, 4-year terms. City supts. appointed by city boards.

Private and Parochial Schools: 28.

Colleges and Universities (accredited): Colleges—white, 20; Negro, 5. Junior colleges—white, 4; Negro, 2. State-supported schools include the University of South Carolina, Columbia; Winthrop College (for women), Rock Hill; The Citadel, Charleston; Medical College of South Carolina, Charleston; Clemson Agricultural College, Clemson; State Colored Normal, Industrial, Agricultural, and Mechanical College, Orangeburg.

Special State Schools: John de la Howe (for dependent children), McCormick; School for the Deaf and Blind, Cedar Springs; State Training School (for mental defectives), Clinton; Convalescent Home for Crippled Children, Florence.

Libraries: City and town public libraries, 18; county library systems, 33; 2 regional libraries serve 5 counties; 1 county contracts for service with a city library. State Library Board aids in improving public library service and in developing county and regional libraries; work headed by librarian and executive secretary. State Department of Education responsible for aid in developing school library service; work headed by supervisor of library services. Noted special library: Charleston Library Society Library, Charleston.

Outstanding Museums: Charleston Museum and Gibbes Art Gallery, both at Charleston; Columbia Museum of Art, Columbia.

CORRECTIONAL AND PENAL INSTITUTIONS

Industrial School for Boys, Florence; Industrial School for White Girls, Industrial School for Negro Girls, John G. Richards Industrial School (for Negro boys), and State Penitentiary, all at Columbia.

LARGEST CITIES (1950 census)

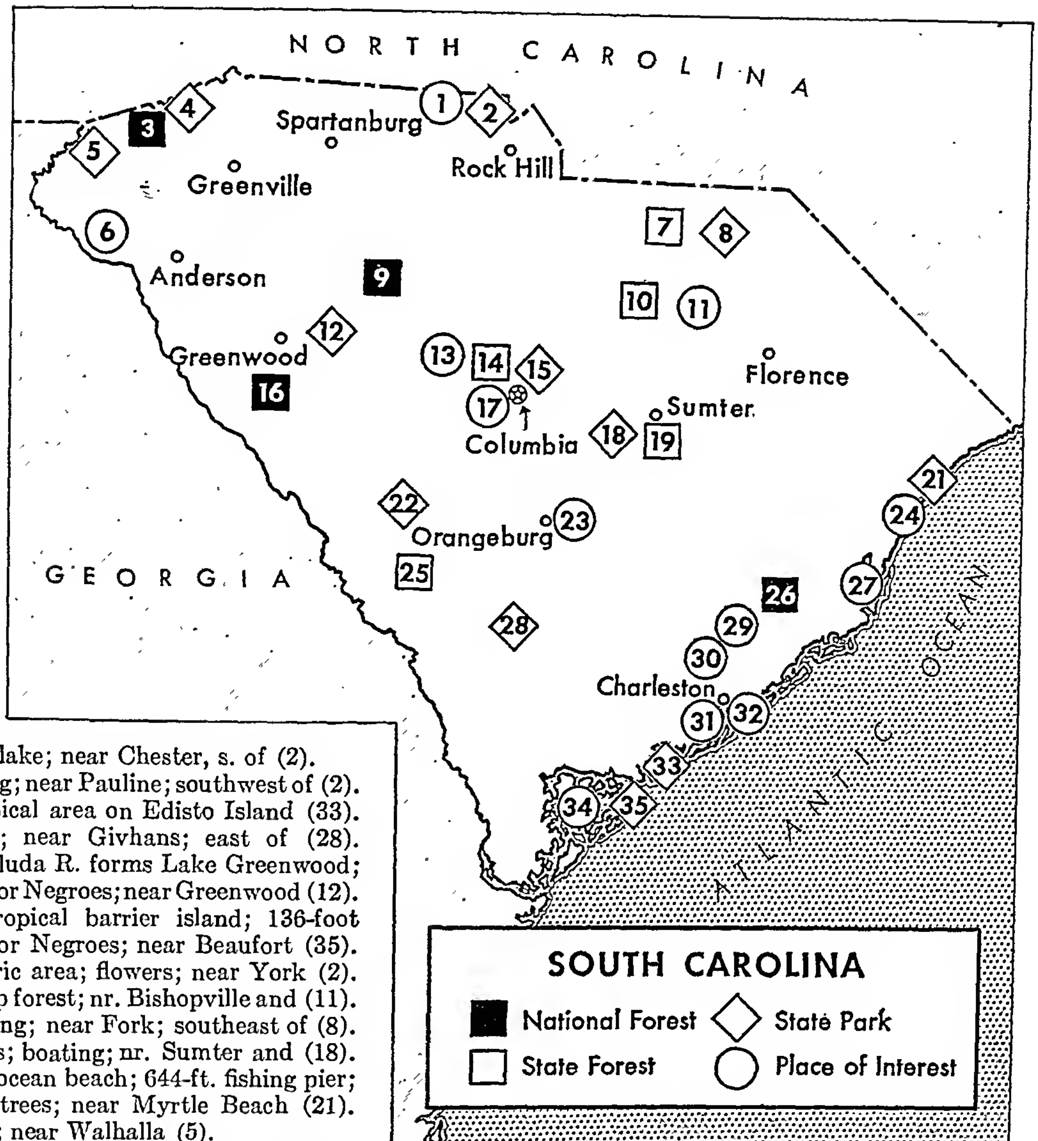
Columbia (86,914): state capital on Congaree River; industries include textile mills, foundries, machine shops, and metalworks; lumber and wood products.
Charleston (70,174): historic city and important Atlantic port; U. S. navy yard; shipbuilding; manufactures cigars, fertilizer, paper and pulp, asbestos products.
Greenville (58,161): textiles, clothing, textile machinery.
Spartanburg (36,795): peach area; textiles; machinery
Rock Hill (24,502): cotton textiles, rayon yarn and fabrics.
Florence (22,513): railroad repair shops; furniture.
Sumter (20,185): furniture, woodworking, machinery.
Anderson (19,770): textiles, sewing machines, glass fibers.

NATIONAL FORESTS*

Francis Marion—414,700 acres; hdqrs., Columbia (26).
Sumter—1,008,639 acres; hdqrs., Columbia (3, 9, 16).

*Numbers in parentheses are keyed to map on the following page.

South Carolina Fact Summary



STATE FORESTS*

Cassatt (Kershaw Co.)—462 a. (10).
Harbison (Richland Co.)—2,202 a. (14).
Manchester (Sumter Co.)—28,838 a. (19).
Sand Hills (Chesterfield and Darlington Cos.)—92,000 a. (7).

STATE PARKS*

Aiken—river, lake; historic site; near Aiken (22).
Andrew Jackson Historical — birthplace of President Jackson; near Lancaster; southeast of (2).
Barnwell—lake; near Barnwell and (22).
Campbell's Pond—for Negroes; swimming; near Cheraw (8).
Cheraw—sandhills; near Cheraw (8).
Chester—forested hills, lake; near Chester, s. of (2).
Croft—forests; swimming; near Pauline; southwest of (2).
Edisto Beach—semitropical area on Edisto Island (33).
Givhans Ferry—fishing; near Givhans; east of (28).
Greenwood—dam on Saluda R. forms Lake Greenwood; water sports; has area for Negroes; near Greenwood (12).
Hunting Island—semitropical barrier island; 136-foot lighthouse; has area for Negroes; near Beaufort (35).
Kings Mountain—historic area; flowers; near York (2).
Lee—Lynches R.; swamp forest; nr. Bishopville and (11).
Little Pee Dee—picnicking; near Fork; southeast of (8).
Mill Creek—for Negroes; boating; nr. Sumter and (18).
Myrtle Beach—smooth ocean beach; 644-ft. fishing pier; Spanish-moss-draped trees; near Myrtle Beach (21).
Oconee—mountain area; near Walhalla (5).
Paris Mountain—woods, lakes; near Greenville and (4).
Pleasant Ridge—for Negroes; mts.; near Marietta and (4).
Poinsett—hills, swamp; named for Joel R. Poinsett, who introduced poinsettia from Mexico; near Sumter (18).
Rivers Bridge Confederate Memorial—historic site; museum; swimming, picnicking; near Ehrhardt (28).
Santee—Lake Marion; at Santee; southeast of (18).
Sesqui-Centennial—purchased by sale of coins when Columbia celebrated its 150th anniversary, 1936 (15).
Table Rock—Table Rock and Stool where, says Indian legend, "Great Chieftain" dined; near Pickens (4).

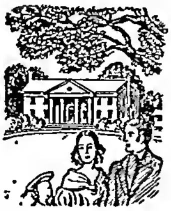
PLACES OF INTEREST*

Belle Isle Gardens—near Georgetown; huge live oaks and colorful japonicas and azaleas (27).
Brookgreen Gardens—outdoor museum with statuary among boxwoods and live oaks; near Georgetown (24).
Castle Pinckney National Monument—part of early defenses of Charleston Harbor built in 1810 (32).
Charleston—Battery Park, Powder Magazine (1703), Charleston Museum (1773) (*see also* Charleston) (31).
Clark Hill Dam—on Savannah R. above Augusta, forms reservoir in S. C. and Ga.; south of symbol (16).
Columbia—Statehouse; Woodrow Wilson's boyhood home from 1871 to 1875 (*see* Columbia) (17).
Cowpens Natl. Battlefield Site—Daniel Morgan defeated Col. Tarleton and British, 1781; nr. Chesnee and (1).
Cypress Gardens—water garden on former rice field reservoir n. of Charleston; mossy cypress, azaleas (29).
Edisto Gardens—municipal gardens in Orangeburg feature wisteria, Japanese cherry trees, and roses (23).
Fort Frederick—restored fort near Port Royal (34).
Fort Hill—John C. Calhoun's home at Clemson (6).
Fort Sumter National Monument—island fort in Charleston harbor; scene of opening battle of Civil War (32).
Kalmia Gardens—large arboretum near Hartsville; named for mountain laurel (*Kalmia latifolia*) (11).
Kings Mountain National Military Park—near York; scene of the British defeat in the South (1780) (1).
Lake Greenwood—impounded by Buzzard Roost Dam on Saluda River; water sports; northwest of (13).
Lake Marion—fishing on largest lake in state created by Santee Dam on Santee River; east of (23).
Lake Moultrie—formed by Pinopolis Dam, off-stream from the Cooper River; fishing; northwest of (29).
Lake Murray—Saluda Dam on Saluda River; fishing (13).
Magnolia Gardens—north of Charleston; includes abundant growth of magnolias, azaleas, and camellias (30).
Middleton Gardens—18th-century formal gardens n.w. of Charleston; camellia and azalea displays (30).

*Numbers in parentheses are keyed to map.

South Carolina Fact Summary

THE PEOPLE BUILD THEIR STATE



1521—Francisco Gordillo, leading expedition sent by Spanish governor of Santo Domingo, Lucas Vásquez de Ayllón, explores coast of present South Carolina.

1526—De Ayllón establishes Spanish colony near Winyah Bay. He dies of fever and colony collapses.

1562—French explorer Jean Ribaut establishes colony on present site of Port Royal, but colony soon fails.

1566—Spaniards build Fort San Felipe on Parris Island.

1629—King Charles I of England grants to Sir Robert Heath the region between 31° and 36° N., the region to be known as Carolina.

1663—King Charles II grants first Carolina charter to group of eight "lords proprietors." Region limited to area between 29° and 36° 30′ N. in second charter granted in 1665.

1667—Dr. Henry Woodward and Capt. Robert Sanford land in Carolina; prepare for English settlement.

1669—John Locke draws up Fundamental Constitution for government of Carolina colony.

1670—First permanent English settlement in Carolina, Charles Town, made on bank of Ashley River; colony moves to present site of Charleston, 1680.

1686—Spaniards from St. Augustine destroy Stuart Town at Port Royal. Growing of rice begins in Carolina.

1693—Commons House receives authority to pass laws.

1706—In climax of Queen Anne's War, Carolinians under Col. William Rhett defeat French and Spanish fleets in attack on Charles Town. Church of England becomes official church of colony.

1715—Yamasee Indians attack settlers; subdued, 1716.

1718—Carolinians under Col. William Rhett free coast of pirates, killing several leaders, including Blackbeard.

1719—Carolinians revolt successfully against proprietary government. Finally, in 1729, all lords proprietors except one sell their interests to the king.

1730—Preliminary boundary fixed between North and South Carolina; final boundary not settled until 1815. Governor Nicholson makes treaty with Cherokee Indians leading to heavy settlement of "up country" region west of fall line.

1744—Growing of indigo begins on commercial scale.

1760—Cherokees attack settlers; subdued, 1761.

1774—Charles Town residents continue to protest Tea Tax; dump cargo of tea into sea (November 1). Provincial Congress elects delegates to Continental Congress.

1775—Provincial Congress votes funds for colony's defense and establishes secret "action committee." Royal Governor Lord William Campbell flees.

1776—Provincial Congress adopts temporary constitution for province. From palmetto log fort colonists repulse British attack on Charles Town Harbor on June 28.

1778—Second state constitution adopted.

1780—British occupy Charles Town after siege from March 12 to May 12, General Benjamin Lincoln surrendering to Gen. Henry Clinton. British overrun state, but are defeated at Kings Mountain, October 7.

1781—Carolinians defeat British at Cowpens, January 17.

1782—British evacuate Charles Town in December after 137 engagements in South Carolina, largely with irregular forces led by men such as Francis Marion.

1783—Charles Town renamed Charleston.

1785—College of Charleston established, first city college in America.

1786—Columbia chosen as state capital, state government finally moving there by 1787.

1788—South Carolina is eighth state to ratify Federal Constitution, May 23; draft of constitution greatly influenced by South Carolinian Charles Pinckney.

1800—Santee Canal links Santee and Cooper rivers.

1801—South Carolina College (now U. of South Carolina) chartered; opened in 1805. Legislature authorizes purchase of patent rights to Whitney cotton gin, thus increasing growing of cotton and use of slaves.

1805—"Up country" and "low country" compromise on representation in legislature, increasing state unity.

1811—State establishes free public school system. State sends John C. Calhoun to Congress; he leads drive to declare war on England, 1812.

1832—Legislature passes Ordinance of Nullification, November 20. Carolina-born President Andrew Jackson orders fleet to South Carolina to enforce federal law, 1833. Calhoun settles dispute with Compromise of 1833.

1833—South Carolina Railroad opens between Charleston and Hamburg; its 136 miles of track is the longest passenger railway in the world at that time.

1846—William Gregg builds cotton mill at Graniteville; is model for South's industrialization. Palmetto Regiment under Gen. Pierce M. Butler is first U.S. force to enter Mexico City in Mexican War.

1860—South Carolina is first state to secede from Union; passes Ordinance of Secession on December 20.

1861—Civil War begins with Confederate forces firing on Fort Sumter in Charleston Harbor, April 12.

1864—Charleston is scene of first submarine warfare.

1865—Sherman's army marches north through the state; Columbia is burned, February 17.

1868—South Carolina readmitted to the Union, June 25.

1876—Gen. Wade Hampton elected governor, restoring state government to local control. But Reconstruction governor refuses to surrender authority until 1877 when President Hayes orders federal troops to evacuate the state.

1886—Farmers' movement to secure rights for small farmers launched, culminating in election of Benjamin R. Tillman as governor in 1890.

1895—Present state constitution adopted.

1930—Saluda Dam on Saluda River completed.

1935—DuBose Heyward's 'Porgy and Bess', drama of Charleston life, wins acclaim as first great U. S. folk opera; operatic score by George Gershwin.

1937—Laws controlling child labor adopted.

1938—South Carolina passes first 40-hour work-week law for textile workers in the U. S.

1942—Santee-Cooper project for power and navigation completed.

1948—Gov. J. Strom Thurmond receives 39 electoral votes as States' Rights presidential candidate.

1949—South Carolina legalizes divorce.

1950—Law passed requiring registration of all voters. Aiken County selected as site of H-bomb project.

1951—General Assembly ratifies amendment repealing poll tax. Sales tax (3%) passed to improve and equalize facilities for white and Negro schools.

1952—Multiple-purpose Clark Hill Dam on Savannah River completed; begins generating power, 1953.

1954—U. S. Supreme Court bans public school segregation in five cases, one involving South Carolina.

SOUTH CAROLINA

COUNTIES

Abbeville	22,456	C 3
Aiken	53,137	D 4
Allendale	11,773	E 6
Anderson	90,664	B 2
Bamberg	17,533	F 5
Barnwell	17,266	E 5
Beaufort	26,993	F 7
Berkeley	30,251	G 5
Calhoun	14,753	F 4
Charleston	164,856	H 6
Cherokee	34,992	D 1
Chester	32,597	E 2
Chesterfield	36,236	G 2
Clarendon	32,215	G 4
Colleton	28,242	F 6
Darlington	50,016	H 3
Dillon	30,930	J 3
Dorchester	22,601	G 5
Edgefield	16,591	D 4
Fairfield	21,780	E 3
Florence	79,710	H 3
Georgetown	31,762	J 5
Greenville	168,152	C 2
Greenwood	41,628	C 3
Hampton	18,027	E 6
Horry	59,820	J 4
Jasper	10,995	E 6
Kershaw	32,287	F 3
Lancaster	37,071	F 2
Laurens	46,974	D 2
Lee	23,173	G 3
Lexington	44,279	E 4
Marion	33,110	J 3
Marlboro	31,766	H 2
McCormick	9,577	C 4
Newberry	31,771	D 3
Oconee	39,050	A 2
Orangeburg	68,726	F 5
Pickens	40,058	B 2
Richland	142,565	F 3
Saluda	15,924	D 3
Spartanburg	150,349	D 2
Sumter	57,634	G 4
Union	31,334	D 2
Williamsburg	43,807	H 4
York	71,596	E 2

CITIES AND TOWNS

Abbeville	5,395	C 3
Adams Run	250	G 6
Adamsburg	150	D 2
Adrian	150	J 4
Aiken	7,083	D 4
Alcolu	800	G 4
Allendale	2,474	E 5
Allsbrook	200	K 3
Anderson	19,770	B 2
Andrews	2,702	H 5
Angelus	50	G 2
Antioch	350	F 3
Antreville	300	B 3
Appleton		E 5
Aragon Mills		E 2

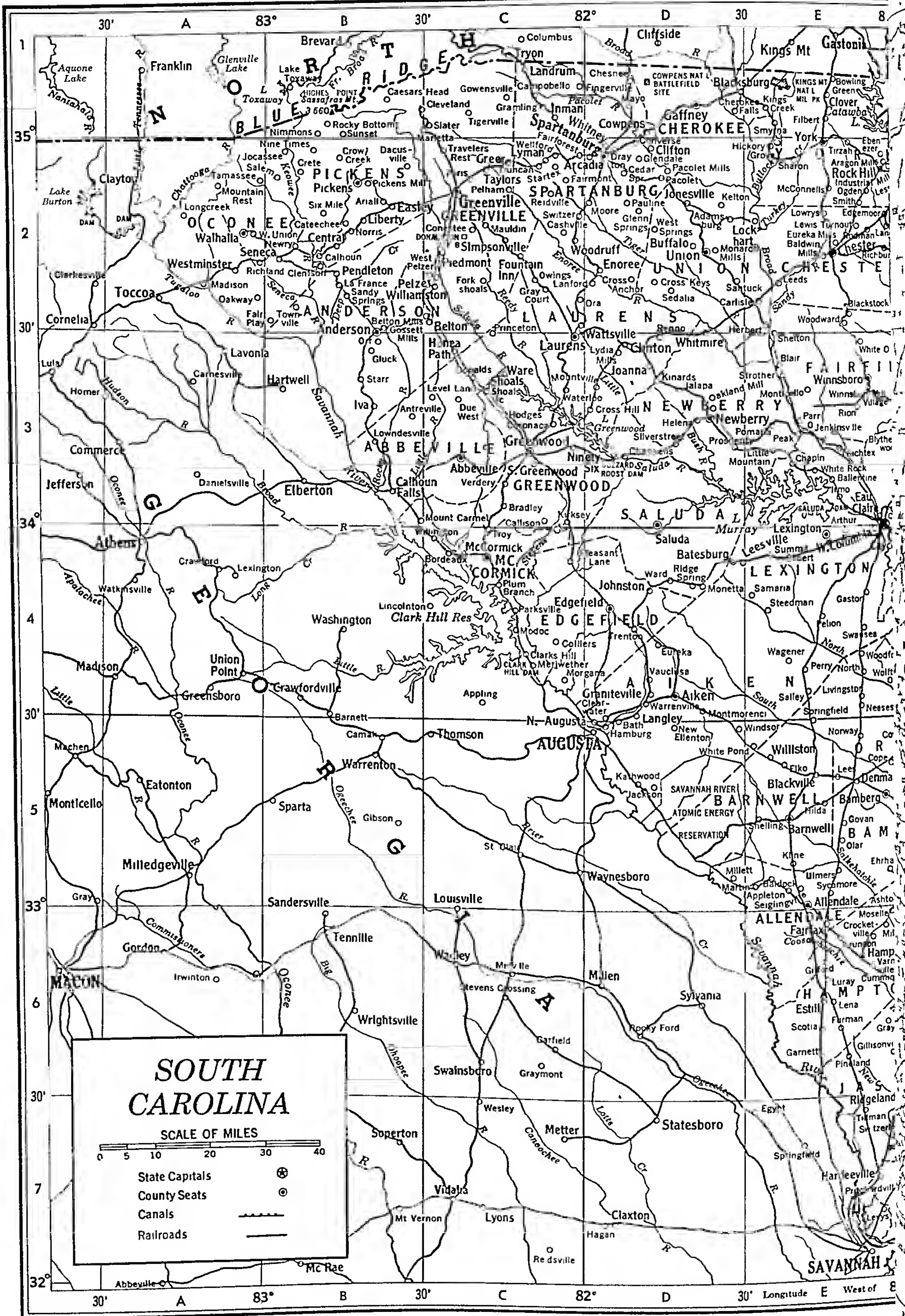
Arcadia	2,554	C 2
Ariail	1,098	B 2
Arthur	50	E 3
Ashepoo	150	G 6
Ashton		E 5
Atkins	50	G 3
Awendaw	75	H 5
Aynor	551	J 3
Badham	118	F 5
Baldock	80	E 5
Baldwin Mills	1,440	E 2
Ballentine	150	E 3
Bamberg	2,954	E 5
Barnwell	2,005	E 5
Batesburg	3,169	D 4
Bath	1,232	D 5
Beaufort	5,081	F 7
Belton	3,371	C 2
Belton Mills	1,500	B 2
Bennetts Point	73	G 6
Bennettsville	5,140	H 2
Bethera		H 5
Bethune	639	G 3
Bingham	169	H 3
Bishopville	3,076	G 3
Blacksburg	2,056	D 1
Blackstock		E 2
Blackville	1,294	E 5
Blair	74	E 3
Blaney	183	F 3
Blenheim	153	H 2
Blue Brick		J 3
Bluffton	474	F 7
Blythewood	400	E 3
Bonneau	408	H 5
Bordeaux	75	B 4
Borden	50	G 3
Bowling Green		E 1
Bowman	857	F 5
Boykin	13	F 3
Bradley	100	C 3
Branchville	1,353	F 5
Bristow	50	H 3
Brogdon	25	G 4
Brookgreen		K 4
Brunson	607	E 6
Bucksport	800	J 4
Bucksville		J 4
Buffalo	1,580	D 2
Burgess	200	J 4
Burnettown	578	*D 5
Burton	275	F 7
Cades	150	H 4
Caesars Head	16	B 1
Calhoun		B 2
Calhoun Falls	2,396	B 3
Callison	50	C 3
Camden	6,986	F 3
Cameron	630	F 4
Campobello	394	C 1
Canadys	150	F 5
Carlisle	405	D 2
Cartersville	96	H 3
Cashville	58	C 2
Cassatt	125	G 3

Catawba	150	F 2
Cateechee	650	B 2
Cayce	3,294	E 4
Cedar Spr.	1,500	D 2
Centenary		J 3
Central	1,263	B 2
Chapin	327	E 3
Chappells	199	D 3
Charleston	70,174	G 6
Cheraw	4,836	H 2
Cherokee Falls		D 1
Chesnee	1,051	D 1
Chester	6,893	E 2
Chesterfield	1,530	G 2
Chisolm	5	F 6
Claremont		G 4
Clarks Hill		C 4
Claussen		H 3
Clearwater	800	D 4
Clemson	1,204	B 2
Cleveland	250	C 1
Clifton	1,707	D 2
Clinton	7,168	D 3
Clio	837	H 2
Clover	3,276	E 1
Colliers	175	C 4
COLUMBIA	86,914	F 4
Conestee	750	C 2
Congaree Field	50	F 4
Converse	1,200	D 2
Conway	6,073	J 4
Cooper	200	H 4
Coosawhatchie		F 6
Cope	209	E 5
Cordesville	450	H 5
Cordova	175	F 5
Coronaca		C 3
Cottageville	553	G 6
Coward	500	H 4
Cowpens	1,879	D 1
Crescent Beach	540	K 4
Creston	75	F 4
Crete		B 2
Crocketville	120	E 6
Cross	85	G 5
Cross Anchor	350	D 2
Cross Hill	543	D 3
Cross Keys	250	D 2
Crow Creek	40	B 2
Cummings		E 6
Dacusville	95	B 2
Dale	300	F 6
Dalzell	209	G 3
Darlington	6,619	H 3
Daufuskie Isl.	270	F 7
Davis Station	200	G 4
Denmark	2,814	E 5
Dents	1,000	F 3
Dillon	5,171	J 3
Donalds	332	C 3
Dorchester	350	G 5
Dovesville	250	H 3
Drake	200	H 3
Drayton	1,228	D 2
Due West	1,033	C 3

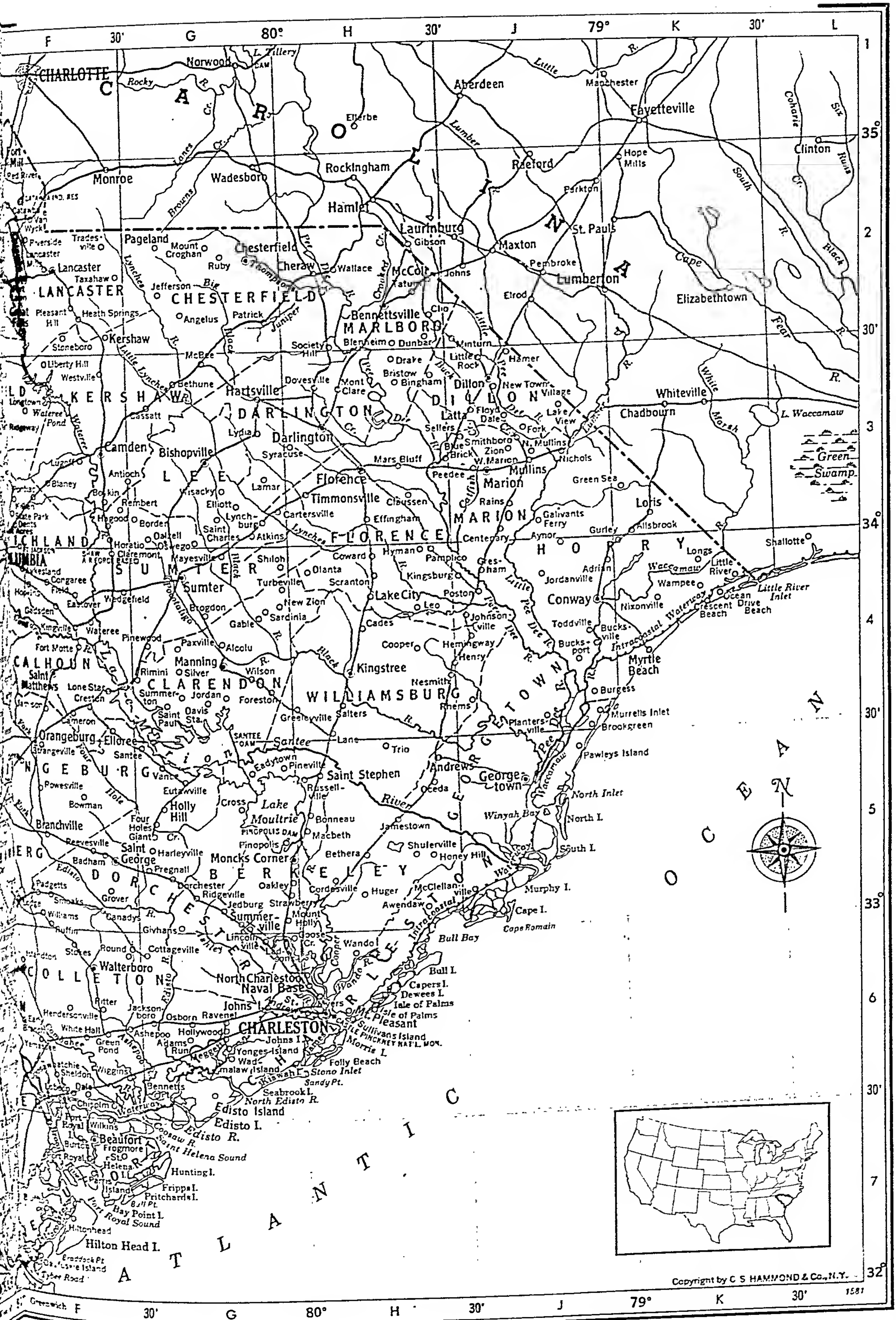
Dunbar	200	H 2
Dunbarton	262	D 5
Duncan	599	C 2
Eadytown	87	G 5
Early Branch	250	F 6
Easley	6,316	B 2
Eastover	564	F 4
Eau Claire	9,238	E 3
Ebenezer	680	E 2
Edgefield	2,518	C 4
Edgemoor	258	E 2
Edisto Isl.	2,500	G 6
Effingham	200	H 3
Ehrhardt	510	E 5
Elko	142	E 5
Ellenton	746	D 5
Elliott		G 3
Elloree	1,127	F 4
Enoree	1,045	D 2
Estill	1,659	E 6
Eureka	50	D 4
Eureka Mills	1,990	E 2
Eutawville	478	G 5
Fair Play	250	A 2
Fairfax	1,567	E 6
Fairforest	800	C 2
Fairmont	250	D 2
Filbert	200	E 1
Fingerville	400	D 1
Florence	22,513	H 3
Floyd Dale	100	J 3
Folly Beach	800	H 6
Forest Acres	3,240	F 3
Foreston		G 4
Fork	115	J 3
Fork Shoals	250	C 2
Fort Lawn	216	F 2
Fort Mill	3,204	F 1
Fort Motte	350	F 4
Fountain Inn	1,325	C 2
Four Holes	200	G 5
Frogmore	200	F 7
Furman	293	E 6
Gable	90	G 4
Gadsden		F 4
Gaffney	8,123	D 1
Galivants Ferry	150	J 3
Garnett	100	E 6
Gaston	250	E 4
Georgetown	6,004	J 5
Giant		G 5
Gifford		E 6
Gilbert	172	E 4
Gillisonville	25	E 6
Givhans	100	G 5
Glendale	1,244	D 2
Glenn Springs		D 2
Gluck	1,634	B 3
Goldville (Joanna)	1,730	D 3
Goose Creek	600	H 6
Gossett Mills		B 2
Govan	109	E 5
Gowensville	100	C 1
Gramling	200	C 1
Graniteville	3,362	D 4

Gray Court	479	C 2
Grays	50	E 6
Great Falls	3,533	F 2
Greeleyville	600	H 4
Green Pond		F 6
Green Sea	500	J 3
Greenville	58,161	C 2
Greenwood	13,806	C 3
Greer	5,050	C 2
Gresham	150	J 4
Grover	145	F 5
Gurley	300	J 3
Hagood	4	F 3
Hamburg		D 5
Hamer	500	J 3
Hampton	2,007	E 6
Hardeeville	546	E 7
Harleyville	483	G 5
Hartsville	5,658	G 3
Heath Springs	694	F 2
Helena		D 3
Hemingway	821	J 4
Hendersonville		F 6
Henry	100	J 4
Herbert	25	E 2
Hickory Grove	275	E 2
Hilda	304	E 5
Hiltonhead	1,600	F 7
Hodges	275	C 3
Holly Hill	1,116	G 5
Hollywood	246	G 6
Honea Path	2,840	C 3
Honey Hill	69	H 5
Hopkins	125	F 4
Horatio	50	G 3
Huger	500	H 5
Hyman	150	H 4
Industrial Mills	1,868	E 2
Inman	1,514	C 1
Irmo	281	E 3
Islandton	25	F 6
Isle of Palms	1,379	H 6
Iva	1,164	B 3
Jackson	500	D 5
Jacksonboro	150	G 6
Jalapa	50	D 3
Jamestown	1,100	H 5
Jamison	75	F 4
Jedburg	500	G 5
Jefferson	556	G 2
Jenkinsville		E 3
Joanna	1,730	D 3
Jocassee	25	A 2
Johns Island	5,000	G 6
Johnsonville	616	J 4
Johnston	1,426	D 4
Jonesville	1,345	D 2
Jordan	15	G 4
Jordanville	150	J 4
Kathwood	30	D 5
Kelton	90	D 2
Kershaw	1,376	G 2
Killian	50	F 3
Kinards		D 3
Kings Creek	140	E 1
Kingsburg	50	H 4

*No room on map for name.



SOUTH CAROLINA
SCALE OF MILES
0 5 10 20 30 40
State Capitals
County Seats
Canals
Railroads
BLUE RIDGE
NORTH
GEORGIA
OCONEE
PICKENS
GREENVILLE
SPARTANBURG
CHEROKEE
YORK
UNION
CHESTER
ANDERSON
LAURENS
NEWBERRY
FAIRFIELD
ABBEVILLE
GREENWOOD
SALUDA
LEXINGTON
MC CORMICK
EDGEFIELD
AIKEN
BARNWELL
ALLENDALE
HAMPTON
SAVANNAH RIVER ATOMIC ENERGY RESERVATION
Clark Hill Res
Lake Murray
AUGUSTA
SAVANNAH
MACON
Athens
Greenville
Spartanburg
Anderson
Greenwood
Aiken
Columbia
Longitude West of



F
30'
G
80°
H
30'
J
79°
K
30'
L
CHARLOTTE
Norwood
L. Tillery
Aberdeen
Manchester
Fayetteville
Ellerbe
Clinton
Monroe
Wadesboro
Rockingham
Raeford
Hope Mills
Parkton
Hamlet
Laurinburg
St. Pauls
Maxton
Pembroke
Lumberton
Elizabethtown
Pageland
Chesterfield
Cheraw
Wallace
McColl
Lancaster
LANCASTER
CHESTERFIELD
Bennettsville
MARLBORO
Kershaw
Hartsville
KERSHAW
DARLINGTON
Darlington
Dillon
DILLON
Whiteville
Chadbourn
L. Waccamaw
Green Swamp
Camden
Bishopville
LEE
Florence
Timmonsville
Mullins
Marion
MARION
Loris
FLORENCE
HORRY
Sumter
SUMTER
Lake City
Conway
Myrtle Beach
Manning
CLARENDON
Kingstree
WILLIAMSBURG
GEORGETOWN
Orangeburg
Georgetown
Andrews
Saint Stephen
Lake Moultrie
Moncks Corner
BERKELEY
DORCHESTER
Summerville
Walterboro
COLLETON
North Charleston
Naval Base
CHARLESTON
Mt. Pleasant
Edisto Island
Beaufort
Hilton Head I.
ATLANTIC OCEAN
35°
34°
33°
32°
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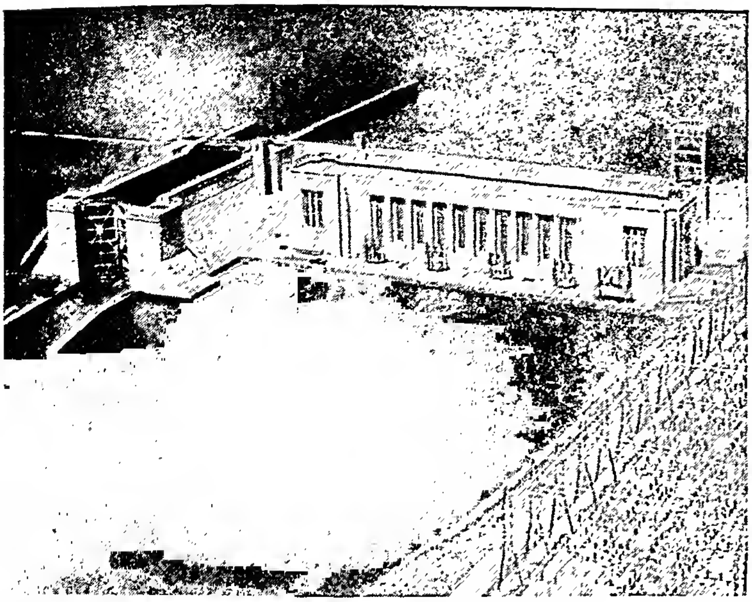
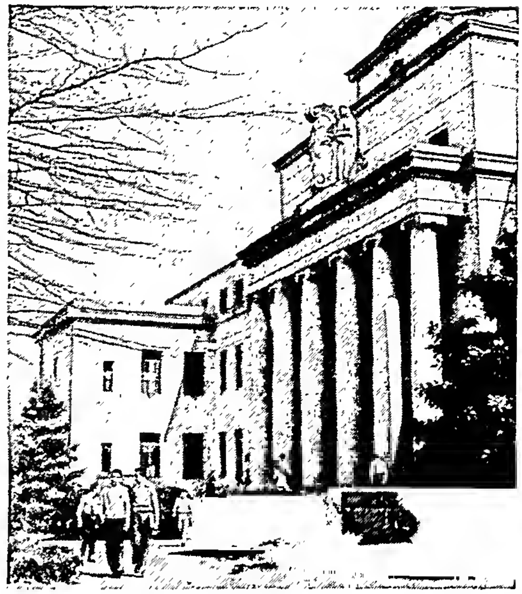
ngstree	3,621	H 4
ngville	100	F 4
rksey		C 3
ine	230	E 5
France		B 2
dson	500	G 6
ke City	5,112	H 4
ke View	653	J 3
mar	958	G 3
ncaster	7,159	F 2
ncaster Mills	4,313	F 2
ndo	500	E 2
ndrum	1,333	C 1
ne	580	H 5
nford	250	C 2
ngley	2,464	D 4
tta	1,602	J 3
urens	8,658	C 3
eds	150	E 2
es	25	E 5
esville	1,453	E 4
na	71	E 6
eo	350	H 4
sslie	275	E 2
vel Land	230	C 3
vys	50	E 7
wis Turnout		E 2
exington	1,081	E 4
iberty	2,291	B 2
iberty Hill	200	F 3
incolnville	278	G 6
ittle Mountain	213	E 3
ittle River	108	K 4
ittle Rock	150	J 3
ivingston	210	E 4
obeco	137	F 6
ockhart	1,685	D 2
odge	316	F 5
one Star	50	F 4
ongcreek	35	A 2
ongs	300	K 4
ongtown		F 3
oris	1,614	K 3
owndesville	252	B 3
owrys	368	E 2
ugoff		F 3
uray	102	E 6
ydia		G 3
ydia Mills	1,212	D 3
ykesland	300	F 4
yman	1,365	C 2
ynchburg	506	G 3
Macbeth	100	H 5
Madison	450	A 2
Manning	2,775	G 4
Marietta	1,000	C 1
Marion	6,834	J 3
Mars Bluff		H 3
Martin		D 5
Mauldin	300	C 2
Mayesville	706	G 4
Mayo	500	D 1
McBee	420	G 3
McClellanville	417	H 5
McColl	2,688	H 2
cConnells	255	E 2
McCormick	1,744	C 4
Meggett	224	G 6
Meriwether		C 4
Meyers Mill	92	D 5
Miley	300	E 6
Millett		D 5
Minturn	47	J 2
Modoc	150	C 4
Monarch Mills	2,158	D 2
Moncks Cor.	1,818	G 5
Monetta		D 4
Mont Clare	150	H 3
Monticello	100	E 3
Montmorenci	425	D 4
Moore	300	D 2
Morgana	50	D 4
Moselle	30	E 6
Mt. Carmel	84	B 3
Mt. Croghan	209	G 2
Mt. Holly		H 5
Mt. Pleasant	1,857	H 6
Mountain Rest		A 2
Mountville		C 3
Mullins	4,916	J 3
Murrells Inlet	50	K 4
Myers		H 6
Myrtle Beach	3,345	K 4
Naval Base	40,000	G 6
Neeses	328	E 4
Nesmith	72	H 4
New Town Village	650	J 3
New Zion	140	H 4
Newberry	7,546	D 3
Newry	1,000	B 2
Nichols	380	J 3
Nimmons	130	B 1
Nine Times		B 2
Ninety Six	1,556	D 3
Nixonville		K 4
Norris	325	B 2
North	954	E 4
N. Augusta	3,659	C 5
N. Charleston	18,000	G 6
N. Mullins	297	J 3
Norway	476	E 5
Oakland Mill	621	D 3
Oakley	150	G 5
Oakway	99	A 2
Ocean Drive Beach	255	K 4
Oceda	300	H 5
Ogden	12	E 2
Olanta	586	H 4
Olar	414	E 5
Ora	185	D 2
Orangeburg	15,322	F 4
Orr	2,625	B 3
Osborn	100	G 6
Oswego	300	G 3
Owings	200	C 2
Pacolet	455	D 2
Pacolet Mills	2,170	D 2
Padgetts	35	F 5
Pageland	1,925	G 2
Pamplico	728	H 4
Paris	200	C 2
Parksville	198	C 4
Parr	100	E 3
Parris Island		F 7
Patrick	310	G 2
Pauline	200	D 2
Pawleys Isl.	2,000	J 5
Paxville	208	G 4
Peak	134	E 3
Peedee	150	H 3
Pelham	750	C 2
Pelion	196	E 4
Pelzer	2,692	B 2
Pendleton	1,432	B 2
Perry	133	E 4
Pickens	1,961	B 2
Pickens Mill	1,000	B 2
Piedmont	2,673	C 2
Pineland		E 6
Pineville	500	H 5
Pinewood	578	G 4
Pinopolis	300	G 5
Plantersville	100	J 4
Pleasant Hill	200	F 2
Pleasant Lane	102	D 4
Plum Branch	158	C 4
Pomaria	251	E 3
Pontiac	45	F 3
Port Royal	793	F 7
Poston	100	J 4
Pregnall	200	G 5
Princeton		C 2
Pritchardville	200	E 7
Prosperity	699	D 3
Rains	50	J 3
Ravenel	337	G 6
Red River	346	F 2
Reevesville	285	F 5
Reidville	236	C 2
Rembert	300	G 3
Renno	100	D 2
Rhems		H 4
Richburg	238	E 2
Richland	75	A 2
Richtex	85	E 3
Ridge Spring	598	D 4
Ridgeland	1,078	E 7
Ridgeville	507	G 5
Ridgeway	414	F 3
Rimini	250	G 4
Rion	500	E 3
Ritter		F 6
Riverside	30	F 2
Robbins	25	D 5
Rock Hill	24,502	E 2
Rocky Bottom	100	B 1
Rodman	750	E 2
Round O	103	F 6
Rowesville	363	F 5
Ruby	315	G 2
Ruffin	500	F 6
Russellville	300	H 5
St. Andrews	20,000	G 6
St. Charles	100	G 3
St. George	1,938	F 5
St. Matthews	2,351	F 4
St. Paul	125	G 4
St. Stephen	1,341	H 5
Salem	504	A 2
Salley	407	E 4
Salters		H 4
Saluda	1,594	D 4
Samaria	100	E 4
Sandy Springs	500	B 2
Santee	107	F 5
Santuck	300	D 2
Sardinia	150	G 4
Scotia	226	E 6
Scranton	602	H 4
Seabrook	500	F 6
Sedalia	300	D 2
Seiglingville		E 5
Sellers	530	H 3
Seneca	3,649	A 2
Sharon	365	E 2
Sheldon	300	F 6
Shelton	50	E 3
Shiloh		G 4
Shoals Jct.	85	C 3
Shulerville	400	H 5
Silver	15	G 4
Silverstreet	201	D 3
Simpsonville	1,529	C 2
Six Mile	157	B 2
Slater	1,000	C 1
Smith	55	E 2
Smithboro	53	J 3
Smoaks	130	F 5
Smyrna	105	E 1
Snelling	34	E 5
Society Hill	645	H 2
South Greenwood	3,712	C 3
Spartanburg	36,795	C 1
Springfield	782	E 4
Starr	282	B 3
Startex	1,638	C 2
State Park		F 3
Steedman	50	E 4
Stokes	80	F 6
Stoneboro	100	F 2
Strangeville	626	F 5
Strawberry		G 5
Strother	25	E 3
Sullivans Isl.	898	H 6
Summerton	1,419	G 4
Summerville	3,312	G 5
Summit	105	E 4
Sumter	20,185	G 4
Sunset	40	B 1
Swansea	762	E 4
Switzer	64	C 2
Switzerland	74	E 7
Sycamore	383	E 5
Syracuse	50	G 3
Tamassee	300	A 2
Tatum	119	H 2
Taxahaw	40	F 2
Taylors	1,518	C 2
Tigerville		C 1
Tillman	500	E 7
Timmonsville	2,001	H 3
Tirzah	75	E 2
Toddville	200	J 4
Townville	250	B 2
Tradesville	125	F 2
Travelers Rest	1,200	C 2
Trenton	296	D 4
Trio	187	H 5
Troy	242	C 3
Turbeville	271	G 4
Ulmers	139	E 5
Union	9,730	D 2
Van Wyck	100	F 2
Vance	106	G 5
Varnville	1,180	E 6
Vaucluse	750	D 4
Verdery	119	C 3
Wadmalaw Isl.	2,500	G 6
Wagener	584	E 4
Walhalla	3,104	A 2
Wallace		H 2
Walterboro	4,616	F 6
Wampee	162	K 4
Wando	114	H 6
Ward	122	D 4
Ware Shoals	3,032	C 3
Warrenville	1,604	D 4
Wateree	100	F 4
Waterloo	162	C 3
Wattsville	1,649	D 3
Wedgefield	450	F 4
Wellford	721	C 2
West Columbia	4,373	E 4
W. Marion	175	J 3
W. Pelzer	578	B 2
W. Springs	300	D 2
W. Union	429	B 2
Westminster	2,219	A 2
Westville	350	F 3
White Hall		F 6
White Oak	200	E 3
White Pond	275	D 5
White Rock	250	E 3
Whitmire	3,006	D 3
Whitney	1,611	D 1
Wiggins	50	F 6
Wilkins	150	F 7
Williams	254	F 5
Williamston	2,782	B 2
Willington	75	B 4
Williston	896	E 5
Wilson	300	G 4
Windsor		D 5
Winnsboro	3,267	E 3
Winnsboro Mills	2,936	E 3
Wisacky	135	G 3
Wolfton	40	E 4
Woodford	179	E 4
Woodruff	3,831	D 2
Woodward	150	E 2
Yemassee	712	F 6
Yonges Island		G 6
York	4,181	E 1
Zion		J 3

A PICTURE JOURNEY IN SOUTH CAROLINA



Pinopolis Dam, with its lock, powerhouse, and switchyard, is part of the huge Santee-Cooper power and navigation system.



At right is McKissick Library of the University of South Carolina, first entirely state-supported university in the nation.

Here are leading products of the factories and farms of South Carolina. At left, an inspector checks bobbins of yarn at an Orlon plant in Camden. The cotton picker, center, represents the most important agricultural crop. Tobacco, right, is second in importance. The farmer is planting seeds with a screen. He covers them with a cloth for protection against frost.

These strange-looking, asterisk-shaped buildings belong to the Atomic Energy Commission's Savannah River Plant for making materials for hydrogen and atomic bombs. The enormous project covers parts of Aiken and Barnwell counties near Aiken.

in 1716. Then they revolted and made James Moore governor. In 1730 they persuaded George I to make South Carolina a royal province.

Under the crown the colony grew in prosperity and population. Owners of the plantations built magnificent country estates. Some of their gardens still lend charm to the "low country." A cultured society developed and Charles Town became the center of gaiety, fashion, and the fine arts. Fine libraries, schools, and theaters were established. The hardy folk in the "up country"—land-hungry settlers from other colonies and German, Scotch-Irish, French Huguenot, and Swiss immigrants—raised rude log cabins, tended their herds, and tilled small farms.

Heroes of Continental Days

Among the men who represented South Carolina in the Continental Congress and left their mark on the state and the nation were Edward Rutledge, Thomas Lynch, Jr., Arthur Middleton, and Thomas Heyward, Jr., signers of the Declaration of Independence.

The first state constitution, drafted in 1776, was temporary, pending settlement of the differences with England; but the second, adopted in 1778, declared the state independent of England.

Colonel William Moultrie and his militia, in a fort of palmetto logs on Sullivan's Island, repulsed the British fleet that brought Sir Henry Clinton's army to attack Charles Town in 1776. When Clinton returned in 1780, he found the state with little defense because its sons were fighting on other fronts. Colonel John Laurens and Col. Charles Cotesworth Pinckney, serving as aides to General Washington, hurried back, and Count Pulaski, the brave Polish leader, brought a small force. However, Charles Town fell, and the British gained control of the state.

Greene and the Mountaineers Defeat Cornwallis

For a time the patriot cause seemed lost, then three great leaders, Gen. Francis Marion, Gen. Andrew Pickens, and Gen. Thomas Sumter, drew about them groups made up chiefly of woodsmen from the "up country" and captives escaped from parole. They were called Partisans and fought bitterly to free the state. The Continental Congress sent Gen. Horatio Gates and 1,400 troops to help, but they were defeated by Cornwallis at Camden. Then Gen. Nathanael Greene was put in command, and mountaineers from the whole Carolina and Virginia frontier joined in the great victory over the British at Kings Mountain. One of the posts from which the British were driven was the splendid plantation home of Mrs. Rebecca Motte on the Congaree River. When the Partisans told Mrs. Motte that they would have to burn the house to drive the enemy away, she handed them a bundle of fire arrows to kindle the flame.

Prosperity returned early to this war-torn state. The cotton gin had been invented, and the "up country" people grew wealthy by raising cotton. The Santee Canal, many highways, and the first railroad (1833) were built to move the cotton crops.

After the piedmont folk protested that the planters in the "low country" were controlling the government, the capital was moved from Charleston (as it was called since 1783) to Columbia in 1786, during the term of Governor Moultrie (1785–87). Representation in the legislature was changed to give the upland dwellers control in the senate.

South Carolina in the Civil War

In national affairs, two South Carolinians, John C. Calhoun and Robert Y. Hayne, led the faction that demanded states' rights and fought also against high tariffs framed to protect Northern industries (*see* Calhoun). South Carolina declared the tariff laws of 1828 and 1832 null and threatened to secede from the Union if force was used to enforce them (*see* Jackson, Andrew). The state did secede in December 1860, after Abraham Lincoln had been elected president, because the people thought he would free the Negro slaves whose labor in the cotton and rice fields meant Carolina's prosperity. (*See* Civil War, American.) South Carolina troops opened the war by firing on Fort Sumter, held by a Federal force. A power in the Confederacy, the state gave freely of men and money during the long years of war. Its capital was burned and miles of countryside were laid waste by General Sherman's troops in 1865 (*see* Sherman).

The years of Reconstruction were as bitter as those of war, with "carpetbaggers"—politicians from the Northern states— and newly enfranchised Negroes in power (*see* Reconstruction Period). But in 1876, the white Democrats gained control and placed Gen. Wade Hampton in the governor's chair. In 1895, after the Farmer's Movement, which sought reforms favoring the upland farmers, had swept Gov. Benjamin R. Tillman into office, a new constitution set up property and literacy qualifications for voting. Divorce, which was prohibited by this constitution, was not legalized until 1949.

The State's Recent Progress

Despite a disastrous earthquake in 1886 and a storm which cost more than 1,000 lives in 1893, South Carolina has developed steadily since Reconstruction days. Its farms were improved and now raise many new products. Cattle raising has become important. New textile mills led in development of manufacturing. Many New England textile plants moved to the South in the 1920's.

The state's balmy climate, varied scenery, and historic spots still attract many visitors. The most popular tourist season is the mild winter and early spring, with its riot of blossoms in old gardens.

Since about 1905 the growth of hydroelectric power in South Carolina has been rapid. In 1951 the state ranked eighth among the states in developed water power. The great Santee-Cooper Project includes the Santee Dam across the Santee River and the Pinopolis Dam off stream from the Cooper. On the Saluda River are the Saluda and Buzzard Roost dams. Forty miles southeast of Clark Hill Dam on the Savannah is the Savannah River Plant, an atomic energy project begun in 1950 for making tritium for hydrogen bombs. (*See also* chronology in South Carolina Fact Summary; United States, section "The South.")

SOUTH DAKOTA, *the* "SUNSHINE STATE"

SOUTH DAKOTA. Except for a mountainous area as large as New Jersey in the southwest corner of the state, South Dakota is a vast rolling plain. The state is in that part of the huge Mississippi Valley which stretches from the Great Lakes to the Rocky Mountains. The yellow Missouri River cuts South Dakota into two nearly equal sections. It enters the state near the center of the northern boundary (just below the 46th parallel) and then flows generally southeast to the Nebraska line. From there it flows almost directly east to form part of the southern boundary.

For years South Dakota's pioneers described their location as east or west of the "river." The development of transportation and communication—railroads, highways, and rural delivery—helped to bind the two sections of the state more closely together. Yet the sections differ considerably in their surface features, history, and growth.

In the center of Pierre stands the impressive State Capitol of South Dakota. It was completed in 1910. The dome overlooks rolling prairie lands stretching for miles into the distance.

The Eastern Part

"East of the river" is rich prairie land like that of Iowa and Illinois. In this section of South Dakota, the water drains from north to south, in the valleys of the James and Big Sioux rivers. They finally flow into the larger, silt-heavy Missouri.

This part of the state has excellent farm areas and almost as much annual rainfall as other parts of the Mississippi Valley to the east. Much of this land is nearly as valuable as that of Iowa, which adjoins the state on its lower eastern boundary. Here also are about four fifths of the state's 59 cities and towns having a population of more than 1,000.

The Western Section

The "west of the river" section is a portion of the Great Plains. Here extensive level stretches of prairie are broken by clusters of low hills and cut by deep ravines of small rivers and creeks. Most of this section has no trees.

Much of this part of the state is open country, a land of great ranches where thousands of cattle and sheep graze. In the central west is a sugar-beet raising area. This was developed through the building of the Belle Fourche Dam on Owl Creek in Butte County in 1905–17. Water from the reservoir flows through 100,000 acres of once semiarid land.

In the southwest are the Black Hills, which are really mountains. They are densely forested except for their eastern edge. The summit of one of the "hills," Harney Peak, is the highest elevation (7,242 feet) east of the Rockies. About 10 miles east of this peak is an odd rock formation called The Needles. The scenic mountains, ridges, canyons, waterfalls, and highways attract thousands of sightseers every year. To preserve these areas for visitors, the state and national governments have set up many fine parks and monuments.

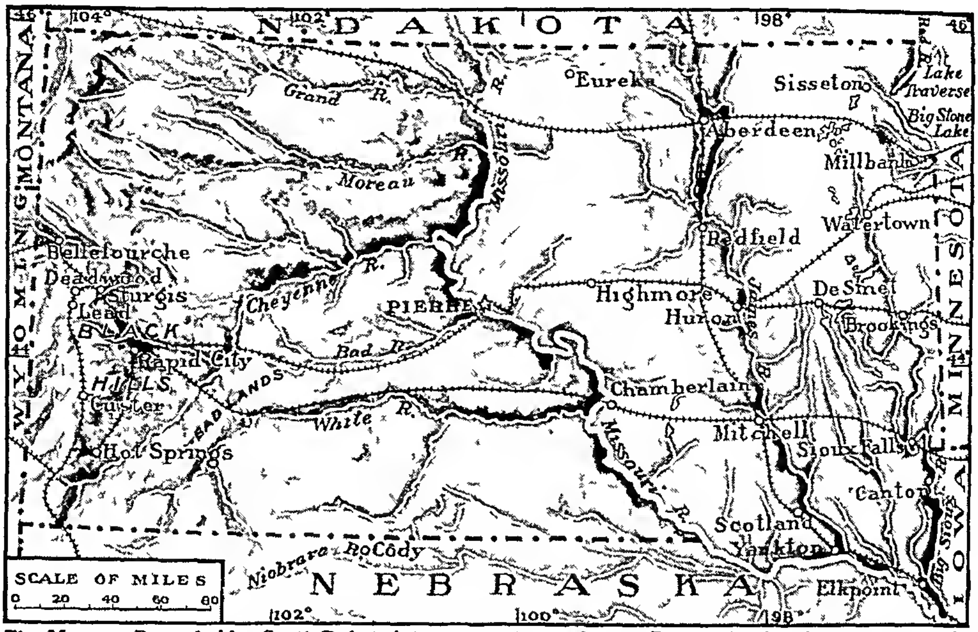
Near Keystone in the Black Hills is the Mount Rushmore National Memorial, whose crest towers 6,000 feet above sea level. This is a monument to the builders of the United States. Carved in granite are the heads of Washington, Jefferson, Lincoln, and Theodore Roosevelt. Their faces appear to look serenely and confidently out over a nearby mountain and valley. This work was begun in 1927 by the noted sculptor Gutzon Borglum. After his death in 1941, the task was completed by his son, Lincoln Borglum. Some idea of the size of these sculptures can be gained from the fact that the faces are carved in the proportion of men 465 feet tall.

Between the Black Hills and the White River lie the famous Bad Lands. They extend along the northwest side of the river for 120 miles and vary in width from 30 to 50 miles. Here, ages ago, was a prehistoric salt sea, which had streams flowing into it but no outlet. The bottom of this inland sea became a sandstone plain which was then deeply eroded. Today the Bad Lands are a labyrinth of tall columns and pinnacles and strange toadstoollike rock tables. Almost the only vegetation is buffalo grass or "blue stem." The harsh colors of these rock formations con-

trast vividly with the pale gray, cream, and rose of the surrounding clay-covered surfaces.

Located a great distance from either ocean, South Dakota has a continental climate of extremes, with hot summers and cold winters. Prevailing northwest winds sweep across the state. The climate is somewhat milder in the Black Hills which help to shelter the aiea.

A STATE OF FARMS AND PLAINS



The Missouri River divides South Dakota into two nearly equal parts. East of the river is a vast and gently rolling plain where corn and other grain crops are raised. Here also are most of the state's cities and towns. West of the river is a high plain broken by hills and mountains. Cattle and sheep graze here.

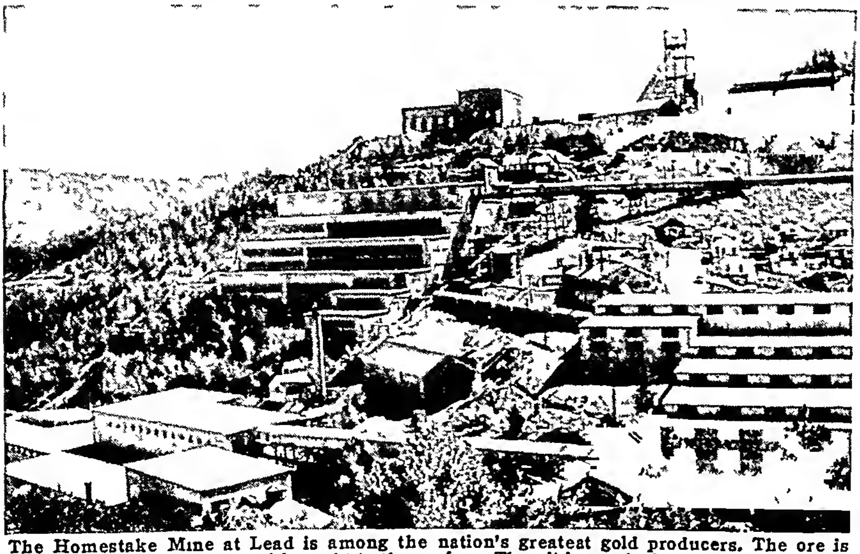
First Settlements

Pierre, the capital, is almost exactly in the center of the state, on the Missouri River. Attracted by the reports of the Lewis and Clark expedition of 1804–6, the American Fur Company built a trading post at Pierre in 1832. But the city has not attained large size, despite being the seat of government and a natural gas and cattle center (*see* Pierre).

Yankton and some neaiby settlements in southeastern South Dakota were started in the 1850's. Their development was retarded, first by the Civil War and then by Indian uprisings in the state. The Indians were led by Spotted Tail, Red Cloud, and Sitting Bull, duiing the peiiod 1862–76.

A great reservation for the Sioux in the center of the state was once a little larger than the state of Maine. It long blocked the way for men fiom the east who had visions of the wealth to be gained in this fine cattle country. It seemed necessary to bieak up the reservation, and the white man has snipped and snipped —about 17,000 squaie miles once, and smaller tracts at other times—until now only a few hundred square miles, held in five scattered reservations, remain to the Indians. The main one is the Pine Ridge reservation, on the southwestern border of the state. Here Sitting Bull and his Sioux were placed after their last fierce outbreak in 1876. In all, about 30,000 Indians, mainly Sioux (or Dakotas), now live in the state. Once the area's only inhabitants, Indians today make up only a very small part of the entiie population of the state.

ONE SOURCE OF SOUTH DAKOTA'S WEALTH



The Homestake Mine at Lead is among the nation's greatest gold producers. The ore is mined deep underground and brought to the surface. Then it is crushed, moved by conveyor belt, and processed step by step in the long low buildings. The end product is fine gold.

Gold Is Discovered

In 1874 a surveying party for the Northern Pacific Railway went into the Black Hills under the protection of Col. George A. Custei of the United States Army. Miners at that time discovered gold at French Creek, in the south part of the Hills, and later in the district now made famous by the gieat Homestake Mine at Lead. The Indian cession of their right to the Black Hills country in 1876 was marked by

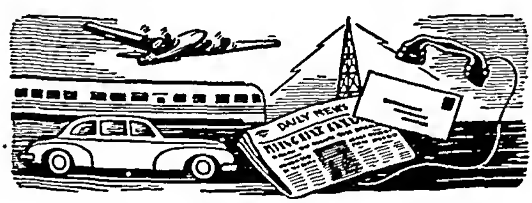
Continued on page 305

South Dakota Fact Summary

SOUTH DAKOTA (S.D.): Named for Indians, the *Lakotas* or *Dakotas*, meaning "friends" or "allies."
Nickname: "The Sunshine State," for its weather; also, "Coyote State."
Seal: The steamboat symbolizes transportation; the smelter, mining; the plowman and cattle, farming.
Motto: Under God the People Rule.
Flag: For description and illustration, *see* Flags.
Flower: American pasque flower. **Bird:** Ring-necked pheasant. **Tree:** Black Hills spruce. **Song:** 'Hail! South Dakota'; words, music by Deecort Hammitt.

THE GOVERNMENT

Capital: Pierre (since 1889).
Representation in Congress: Senate, 2; House of Representatives, 2. Electoral votes, 4.
State Legislature: Senators, 35; term, 2 years. Representatives, 75; term, 2 years. Convenes Tuesday after first Monday in January in the odd-numbered years. Session limit, 60 days.
Constitution: Adopted 1889. Proposed amendment must be (a) passed by a majority of elected members in each house of the legislature and (b) ratified by a majority voting on amendment at a popular election.
Governor: Term, 2 yrs. Two consecutive terms allowed.
Other Executive Officers: Lieut. governor, secy. of state, attorney general, auditor, treasurer, commissioner of school and public lands, superintendent of public instruction, all elected; terms, 2 years. Public utilities commissioners—3; elected; term, 6 years.
Judiciary: Supreme court—5 justices, nominated by districts, but elected by entire state; term, 6 years. Circuit courts—12 districts; 20 judges elected; term, 4 years. County courts—1 in each county; judge elected; term, 2 years.
County: 64 organized counties, each governed by a board of 3 or 5 commissioners; board elected; term, 4 years; officers elected; term, 2 years. Also 4 unorganized counties, each attached to an organized county for purposes of government.
Municipal: Cities may have commission or aldermanic plan. Boards of trustees govern incorporated towns.
Voting Qualifications: Age, 21; residence in state, 1 year; in county, 90 days; in district, 30 days.



TRANSPORTATION AND COMMUNICATION

Transportation: Railroads, 4,000 miles. First railroad, Sioux City (Iowa) to Yankton, 1872. Rural roads, 93,600 miles. Airports, 73.
Communication: Periodicals, 21. Newspapers, 180. First newspaper, *The Democrat*, Sioux Falls, 1859. Radio stations (AM and FM), 15; first station, WCAT, Rapid City, licensed May 9, 1922. Television stations, 1; KELO-TV, Sioux Falls, began operation May 1, 1953. Telephones, 166,000. Post offices, 539.

THE PEOPLE AND THEIR LAND

Population (1950 census): 652,740 (rank among 48 states—40th); urban, 33.2%; rural, 66.8%. Density: 8.5 persons per square mile (rank—41st state).
Extent: Area, 77,047 square miles, including 511 square miles of water surface (15th state in size).
Elevation: Highest, Harney Peak, 7,242 ft., near Oreville; lowest, Big Stone Lake, 962 ft., in northeastern S. D.
Temperature (°F.): Average—annual, 46°; winter, 19°; spring, 45°; summer, 70°; fall, 48°. Lowest recorded, −58° (McIntosh, Feb. 17, 1936); highest recorded, 120° (Gannvalley, July 5, 1936).
Precipitation: Average (inches)—annual, 19; winter, 2; spring, 6; summer, 8; fall, 3. Varies from about 12 in northwest corner to about 26 in southeast.
Natural Features: Missouri River flows from north to south through middle of state, dividing it roughly into two parts; rich prairie land lies east of river; plains broken by low hills, deep ravines lie west. Black Hills, with jagged ridges, canyons, forests, and waterfalls, lie in southwest. Principal rivers: Big Sioux, Cheyenne, Grand, James, Missouri, Moreau, White.
Land Use: Cropland, 39%; nonforested pasture, 51%; forest, 4%; other (roads, parks, game refuges, wasteland, cities, etc.), 6%.

Natural Resources: *Agricultural*—fertile, arable land of eastern section and ample rainfall in this region produce high crop yield; western section well suited for stock grazing. *Industrial*—valuable deposits of gold, stone, clays, sand and gravel; forest land. *Commercial*—abundant wildlife, game, fish attract thousands of sports lovers.

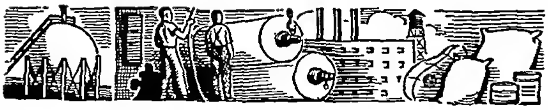
OCCUPATIONS AND PRODUCTS

What the People Do to Earn a Living

Major Industries and Occupations, 1950

Fields of Employment	Number Employed	Percentage of Total Employed
Agriculture, forestry, and fishery	98,229	40.7
Wholesale and retail trade	42,977	17.7
Professional services (medical, legal, educational, etc.)	21,317	8.8
Construction	15,111	6.2
Transportation, communication, and other public utilities	12,995	5.4
Manufacturing	11,781	4.9
Government	9,543	3.9
Personal services (hotel, domestic, laundering, etc.)	9,512	3.9
Business and repair services	6,856	2.8
Finance, insurance, and real estate	4,935	2.0
Mining	2,731	1.1
Amusement, recreation, and related services	2,041	0.8
Workers not accounted for	4,240	1.8
Total employed	242,268	100.0

South Dakota Fact Summary



What the People Produce

A. Manufactured Goods (Rank among states—45th)
Value added by manufacture* (1952), $76,022,000

Leading Industries in 1947 (with Principal Products)	Value Added by Manufacture	Rank among States
FOOD AND KINDRED PRODUCTS	$35,246,000	35
Meat packing; bakery products		
PRINTING AND PUBLISHING	5,566,000	41
Newspapers		
LUMBER AND PRODUCTS	3,506,000	42
MACHINERY (EXCEPT ELECTRICAL)	2,398,000	39

* For explanation of value added by manufacture, see Census.

B. Farm Products (Rank among states—19th)
Total cash income (1951), $607,080,000

Products	Amount Produced (10-Year Average)	Rank within State*	Rank among States†
Corn..........	92,154,000 bu.	1	9
Cattle..........	614,555,000 lbs.	2	11
Hogs..........	569,780,000 lbs.	3	9
Wheat.........	41,358,000 bu.	4	9
Oats	86,060,000 bu.	5	5
Milk	767,000,000 qts.	6	21
Barley	32,982,000 bu.	7	4

*Rank in dollar value †Rank in units produced

C. Minerals (Fuels, Metals, and Stone)
Annual value (1951), $29,658,000
Rank among states—35th

Minerals (1951)	Amount Produced	Value
Gold..............	458,000 ozs.	$16,034,000
Stone..............	1,263,000 tons	4,660,000
Clays...	255,000 tons	2,923,000
Sand and gravel.....	5,037,000 tons	2,502,000

D. Trade

Trade (1948)	Sales	Rank among States
Wholesale.......	$791,608,000	36
Retail..	622,192,000	38
Service ..	33,895,000	44

LARGEST CITIES (1950 census)

Sioux Falls (52,696): tri-state commercial and industrial center; meat packing and livestock marketing.
Rapid City (25,310): eastern gateway to Black Hills; tourist center; livestock market; U. S. air base.
Aberdeen (21,051): railroad center of fertile James River valley; in-transit stock feeding; machinery.
Huron (12,788): food products; pheasant hunting.
Watertown (12,699): agricultural marketing.
Mitchell (12,123): center of rich agricultural area.
Brookings (7,764): hub of fertile agricultural region.
Yankton (7,709): farm marketing; nurseries.
Lead (6,422): gold mining and agricultural center.
Pierre (5,715): state capital; farming, stock-raising area.
Vermillion (5,337): Univ. of South Dakota; in farm area.

EDUCATION

Public Schools: Elementary, 3,501; secondary, 271. Compulsory school age, 7 through 15. State Board of Education consists of the superintendent of public instruction and 7 members appointed by governor for 7-yr. terms. State supt. of public instruction elected for 2-yr. term. School boards consisting of 5 members elected in each county or central high-school district for 3-yr. terms. County supts elected in each county for 2-yr. terms. City boards of education, elected by popular vote, appoint city supts
Private and Parochial Schools: 75.
Colleges and Universities (accredited): Colleges, 16; junior colleges, 3. State-supported schools include the University of South Dakota, Vermillion; South Dakota State College, Brookings; School of Mines and Technology, Rapid City; 4 teachers colleges—at Aberdeen, Madison, Spearfish, and Springfield.
State Schools for the Handicapped: School for the Deaf, Sioux Falls; School for the Blind, Gary; School for the Feeble-minded, Redfield.
Libraries: City and town public libraries, 58; independent county libraries, 8. Free Library Commission responsible for aid in developing library service.
Outstanding Museums: Historical Society Museum, Pierre; Rapid City Indian Museum, Rapid City; Pettigrew Museum, Sioux Falls.

CORRECTIONAL AND PENAL INSTITUTIONS

South Dakota Training School, Plankinton; South Dakota Penitentiary and Reformatory, Sioux Falls.

STATE PARKS*†

Custer—70,000 acres of mountain beauty; granite spires along Needles Highway; Sylvan Lake (26)
Farm Island—area in Missouri River near Pierre (16).
Fisher Grove—near Redfield; early crossing used during stagecoach days preserved as historical marker (11).
Hartford Beach—n.w. of Milbank; wooded park on Big Stone Lake; Indian mounds; first fur-trading post (10).
Lake Herman—near Madison; named for Herman Luce, first white settler, whose log house still stands (33).
Lake Hiddenwood—n. e. of Selby; forested area (7).
Newton Hills—s. of Canton on Big Sioux River; forested hills, deep ravines; once bandit hideout (36)
Oakwood Lakes—cluster of several forested lake areas; site of army fort (1862) at Little Round Lake (21).
Roy Lake—nr. Lake City; wooded lake area; n. e. of (9).
Union County—s. of Beresford; site of early land survey made soon after Dakota became a territory (37).

STATE FOREST LAND*‡

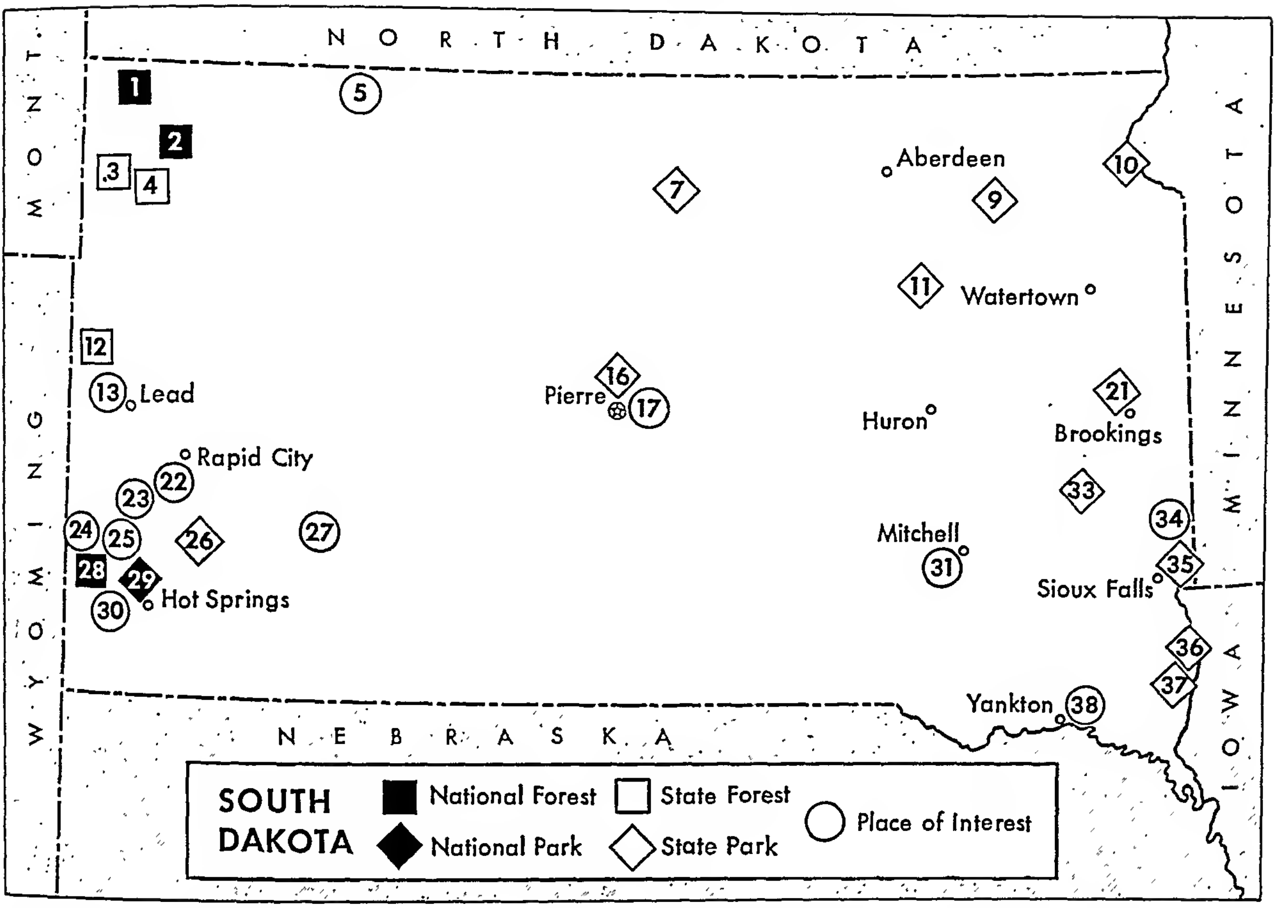
Short Pine Hills (Harding Co.)—17,000 acres (3, 4).
Spearfish Deer Range (Lawrence Co.)—5,000 acres (12).
(Tracts of scattered school lands throughout Black Hills total 36,000 acres.)

NATIONAL PARK*

Wind Cave—27,886 acres in Black Hills; limestone caves; named for currents blowing through cavern's mouth; bison, antelope, elk, deer in wild-game preserve (29).

*Numbers in parentheses are keyed to map
† Also 13 State Recreation Areas, 9 State Recreation Development Areas, 19 State Co-operative Recreation Areas, and 12 Roadside Parks
‡ Custer State Park includes 70,000 acres of forested land, the school lands in Black Hills are too scattered to be located on map

South Dakota Fact Summary



NATIONAL FORESTS*

Black Hills—1,325,531 acres in state; total, 1,524,997 acres in S. D. and Wyo.; hdqrs., Custer (28).

Custer—77,826 acres in state; total, 1,274,395 acres in S. D. and Mont.; hdqrs., Billings, Mont. (1, 2).

PLACES OF INTEREST*

Annie D. Tallent Monument—near Custer; honors 1st white woman in Black Hills; she came with Gordon party (1874); Gordon Stockade (replica) nearby (25).

Badlands National Monument—between White and Cheyenne rivers, near Interior; fantastic ridges, columns, ravines carved by erosion; large fossil beds (27).

Corn Palace—Mitchell; only building of kind in world; ear corn, grain sorghums, grasses cover walls; festival climaxes harvest season each year (31).

Custer—oldest town in Black Hills; situated on French Creek near spot where gold was first discovered; Log Cabin Museum built by General Crook's soldiers in 1875 exhibits relics associated with early history of area; stuffed animals, mineral specimens (25).

Deadwood—historic frontier mining town which celebrates the days of '76 each year; Adams Memorial Museum has collection of mementos; Mount Moriah ("Boot Hill") Cemetery includes graves of Wild Bill Hickok, Calamity Jane, Preacher Smith, Seth Bullock (13).

Devil's Gulch—Garretson; fantastic gorge with pink and purple walls; seemingly bottomless crevices (34).

Fossil Cycad National Monument—near Hot Springs; fossilized fernlike plants from dinosaur age; not open to the public (30).

Harney Peak—near Custer; state's highest point, 7,242 feet; lookout station at summit (23).

Homestake Mine—in Lead; largest producing gold mine in U. S.; in operation since 1877 (13).

Jewel Cave National Monument—west of Custer; limestone chambers; fine calcite crystals on walls (24).

Mount Rushmore National Memorial—near Keystone; heads of Washington, Jefferson, Theodore Roosevelt, and Lincoln carved into gigantic outcropping of granite (23).

Norbeck Memorial—honors Sen. Peter Norbeck, a conservationist; on Iron Mountain near Mount Rushmore; scenic drive and view (23).

Old Fort Sisseton—near Eden; army post built in 1864 during Indian troubles; near (9).

Petrified Wood Park—Lemmon; petrified wood, fossils; miniature castle of petrified wood and grass (5).

Pierre—State Capitol (1910); Soldiers' and Sailors' Memorial Hall (1930–32) houses Historical Museum; on display is lead plate buried by Vérendrye expedition in 1743 and found in 1913 (*see* Pierre) (17).

Rapid City—eastern Black Hills gateway; life-sized replicas of prehistoric animals in Dinosaur Park along Skyline Drive (22).

Roosevelt Monument—Theodore Roosevelt memorial at top of Mt. Roosevelt; view of North Dakota, South Dakota, Wyoming, Montana from summit (13).

Sitting Bull's Grave—near Mobridge; South Dakotians raided grave in North Dakota in 1953; northwest of (7).

Yankton—capital of Dakota Territory, 1861–83; site of territorial capitol marked by bronze tablet (38).

Projects of the Missouri River Basin Development Program include: Angostura Dam, southeast of (30); Fort Randall Dam and Gavins Point Dam, both west of (38); Oahe Dam, near (16); Pactola Dam, near (22); and Shadehill Dam (5) (*see* Missouri River).

*Numbers in parentheses are keyed to map.

South Dakota Fact Summary

THE PEOPLE BUILD THEIR STATE

1699—Pierre LeSueur, French trader, believed to have been in area around Sioux Falls.

1743—François and Louis Joseph de la Vérendrye claim Dakota region for French king; bury inscribed plate near Fort Pierre; plate found, 1913.

1762—France cedes Louisiana region to Spain; includes present South Dakota.

1785—Pierre Dorion, later a guide to Lewis and Clark, settles along James River; believed to have been first white resident in state.

1794—Jean Baptiste Trudeau sets up trading post, builds first house in territory in present Charles Mix Co.

1800—Ree (Arikara) Indians, harassed by Sioux, retreat northward, allowing Sioux to occupy region. Spain secretly returns Louisiana territory to France.

1803—U. S. buys Louisiana territory from France.

1804—Lewis and Clark Expedition explores Missouri Valley through South Dakota on way to Pacific coast.

1807—First conflict between Indians and U. S. troops in Dakota region takes place on Grand River.

1811—Wilson Price Hunt, fur trade agent for John Jacob Astor, explores northern Black Hills region.

1812—Manuel Lisa, New Orleans trader, builds Fort Manuel in present Corson County.

1813—Indians destroy Fort Manuel. Lisa sets up new post near Big Bend. Lisa also persuades Sioux to cease aiding British in War of 1812.

1815—U. S. signs peace treaty with Sioux at council at Portage des Sioux near Missouri River.

1817—Joseph la Framboise, French trader, establishes post at present Pierre; site considered oldest continuously settled in state.

1822—Columbia Fur Company rebuilds La Framboise post as Fort Tecumseh.

1823—Ree Indians attack Gen. William Ashley's trading party at Grand River; Col. Henry Leavenworth's campaign against Rees avenges this attack.

1828—Astor's American Fur Company absorbs Columbia Fur Company, dominates Dakota trade.

1831—Pierre Chouteau, Jr., sends his steamboat *Yellowstone* up the Missouri River into South Dakota.

1832—American Fur Company builds Fort Pierre Chouteau (now Pierre) to replace Fort Tecumseh.

1838—Joseph Nicollet, French scientist, and John C. Frémont visit eastern South Dakota.

1854—Nebraska Territory organized, outlining South Dakota's southern border; eastern boundary established, 1858, when Minnesota becomes a state. Settlers begin agitation for status as territory.

1855—U. S. government buys Fort Pierre.

1858—Yankton Sioux cede most of territory in southeastern region between Missouri and Big Sioux rivers; territory settled in land rush, 1859; farms started near sites of Bon Homme, Yankton, and Vermillion. Provisional territorial government organized at Sioux Falls.

1860—Presbyterians organize first church in region at Vermillion. First schoolhouse in state built in Bon Homme County by public subscription.

1861—Dakota Territory organized March 2; includes what is now North and South Dakota and parts of Wyoming and Montana east of the Great Divide. President Lincoln names his physician, Dr. William Jayne, the first territorial governor.

1862—First territorial legislature meets at Yankton, the capital. In War of the Outbreak, Indians kill settlers near Sioux Falls; settlement is evacuated.

1864—Montana Territory separated from Dakota Territory; divided along present state boundary between South Dakota and Montana.

1865—First grasshopper plague strikes; worst ones come 1872–77. Government orders road built from California Trail near Fort Laramie, Wyo., through Powder River valley to gold mines in Montana

1866—Sioux Chief Red Cloud resists survey of proposed road to Montana; Red Cloud War begins. Peace treaty signed, 1868. All territory west of Missouri River in Dakota area set up as great Sioux reservation. Wyoming Territory separated from Dakota Territory along present border, July 25, 1868.

1874—Custer Expedition discovers gold at French Creek in Black Hills, causing gold rush to area.

1876—Indians attack white settlers coming illegally to Black Hills. Colonel Custer and his men killed in battle of Little Bighorn (in Montana). Sioux cede Black Hills region to United States. Moses Manuel locates Homestake gold lode.

1877—Dakota land boom begins, covers 1877–85.

1879—Settlers want Dakota Terr. divided into two states.

1881—Yankton College founded, first college in Territory.

1882—University of Dakota opens at Vermillion; becomes state university in 1889.

1883—Bismarck becomes territorial capital. First constitutional convention held at Sioux Falls. Gen. William Beadle persuades Territory to sell school land for a minimum of $10 an acre. State College of Agriculture and Mechanic Arts founded at Brookings.

1889—Congress establishes division of Territory into North and South Dakota. South Dakota admitted to Union, November 2; temporary capital, Pierre. Messiah War marks last Indian trouble in state; Sitting Bull killed; war ends with massacre of Indians at Wounded Knee, Dec. 29, 1890.

1890—Large areas of Sioux Reservation opened for white settlement; Sioux limited to five small sectors.

1898—South Dakota is first state to adopt initiative and referendum.

1905—Pierre selected over Mitchell as state capital; permanent capitol building dedicated in 1910. Belle Fourche Dam begun; work continued until 1917.

1915—State Bank Guaranty Law passed; creates fund to pay depositors of closed banks; later inoperative.

1917—Rural credits law permits landowners to borrow money from state government.

1923—Program begun for Missouri River at Rosebud, Chamberlain, Pierre, Forest City, and Mobridge.

1927—Mount Rushmore Memorial dedicated. Pres. Coolidge makes Rapid City "summer White House."

1933—Gold price increase renews mining in Black Hills. Dust storms begin; devastate farms until 1936.

1934—National Geographic Society-U. S. Army balloon *Explorer* makes first stratosphere ascent from Stratosphere Bowl, near Rapid City.

1935—*Explorer II* makes ascent from base near Rapid City; rises 72,395 feet in air, a record height.

1947—State permits women to serve on juries.

1952—South Dakota bottomlands and towns, including Pierre, hit by worst Missouri River flood.

1954—Fort Randall Dam on Missouri River begins generating power at signal from President Eisenhower.

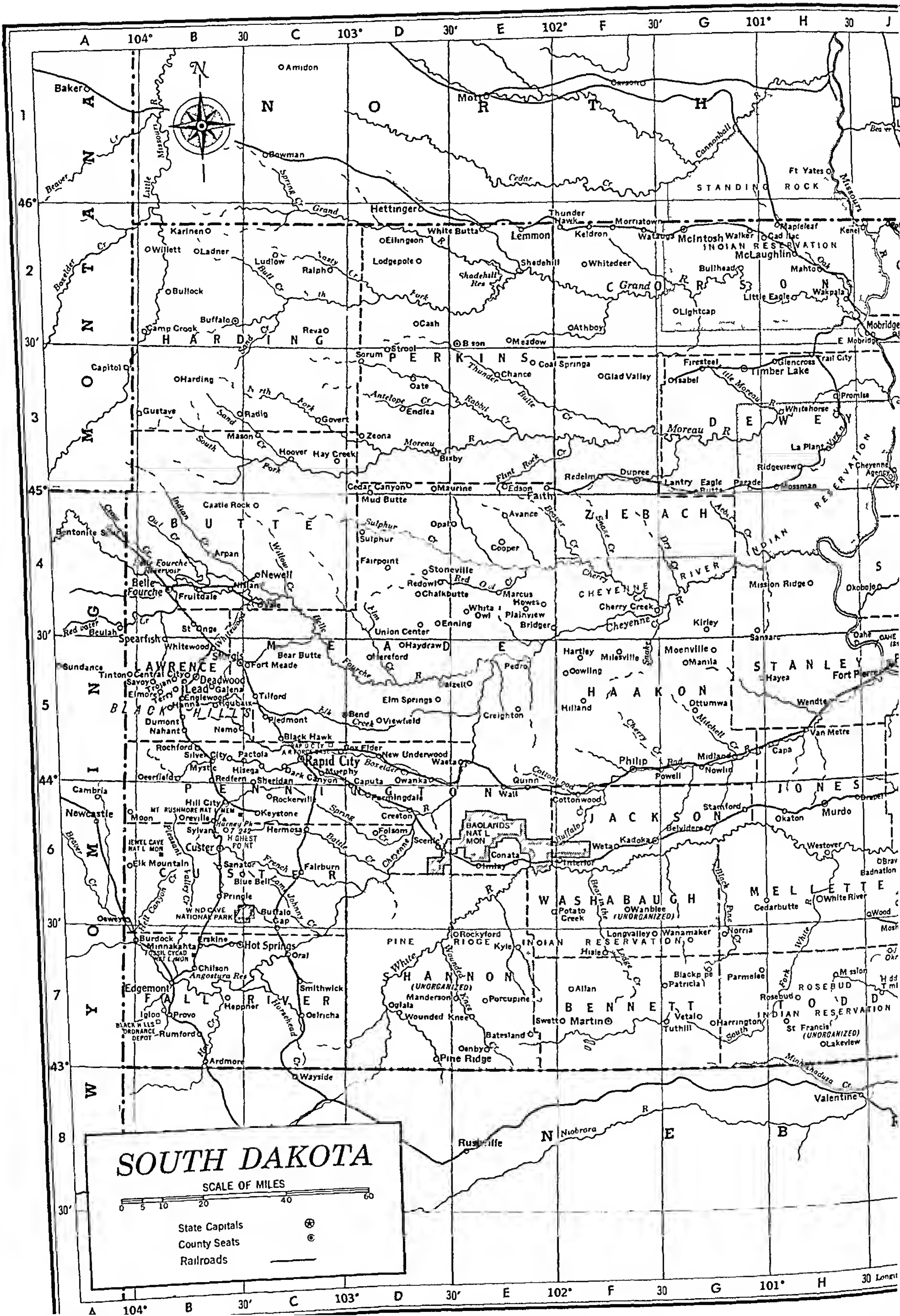
SOUTH DAKOTA

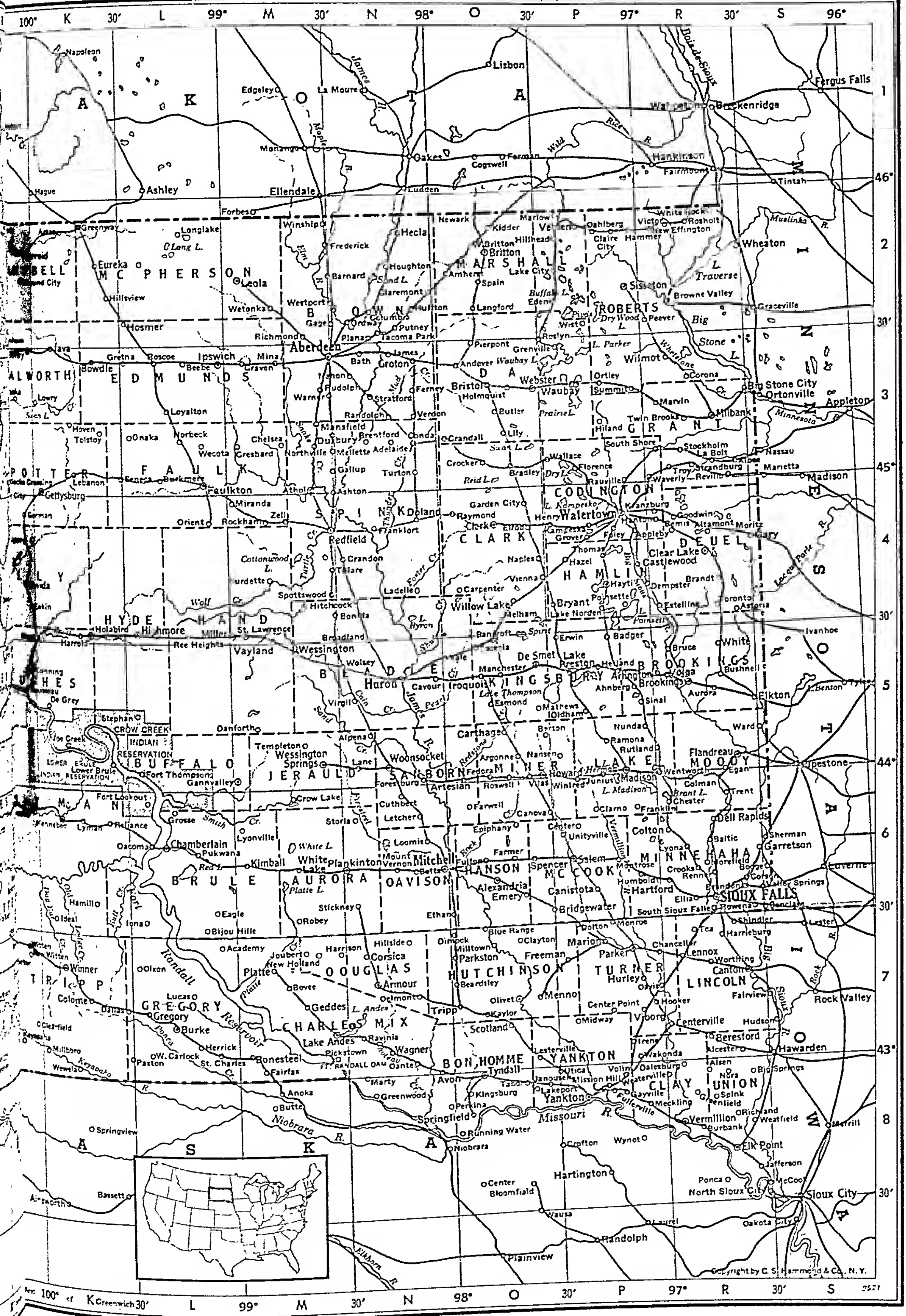
COUNTIES

Aurora	5,020	M 6
Beadle	21,082	N 5
Bennett	3,396	F 7
Bon Homme	9,440	O 7
Brookings	17,851	R 5
Brown	32,617	N 2
Brule	6,076	L 6
Buffalo	1,615	L 5
Butte	8,161	B 4
Campbell	4,046	J 2
Charles Mix	15,558	M 7
Clark	8,369	O 4
Clay	10,993	P 8
Codington	18,944	P 4
Corson	6,168	G 2
Custer	5,517	B 6
Davison	16,522	N 6
Day	12,294	O 3
Deuel	7,689	R 4
Dewey	4,968	G 3
Douglas	5,636	N 7
Edmunds	7,275	L 3
Fall River	10,439	B 7
Faulk	4,752	L 3
Grant	10,233	R 3
Gregory	8,556	L 7
Haakon	3,167	F 5
Hamlin	7,058	P 4
Hand	7,149	L 4
Hanson	4,896	O 6
Harding	2,289	B 2
Hughes	8,111	J 5
Hutchinson	11,423	O 7
Hyde	2,811	K 4
Jackson	1,768	F 6
Jerauld	4,476	M 5
Jones	2,281	H 6
Kingsbury	9,962	O 5
Lake	11,792	P 5
Lawrence	16,648	B 5
Lincoln	12,767	R 7
Lyman	4,572	J 6
Marshall	7,835	O 2
McCook	8,828	P 6
McPherson	7,071	L 2
Meade	11,516	D 5
Mellette	3,046	H 6
Miner	6,268	O 5
Minnehaha	70,910	R 6
Moody	9,252	R 5
Pennington	34,053	C 6
Perkins	6,776	D 3
Potter	4,688	J 3
Roberts	14,929	P 2
Sanborn	5,142	N 5
Shannon	5,669	D 7
Spink	12,204	N 4
Stanley	2,055	H 5
Sully	2,713	J 4
Todd	4,758	H 7
Tripp	9,139	K 7
Turner	12,100	P 7
Union	10,792	R 8
Walworth	7,648	J 3
Washabaugh	1,551	F 6
Yankton	16,804	P 7
Zieback	2,606	F 4

CITIES AND TOWNS

Aberdeen	21,051	M 3
Academy	20	M 7
Adelaide		N 3
Agar	141	J 4
Ahnberg	3	P 5
Akaska	84	J 3
Albee	75	S 3
Alcester	585	R 7
Alexandria	714	O 6
Allen	130	F 7
Alpena	426	N 5
Alsen	22	R 8
Altamont	76	R 4
Amherst	70	O 2
Andover	277	O 3
Appleby	8	R 4
Ardmore	107	B 7
Argonne	25	O 5
Arlington	1,096	P 5
Armour	900	N 7
Arpan	50	B 4
Artas	172	K 2
Artesian	429	O 6
Ashton	222	N 3
Astoria	206	S 4
Athboy	2	F 2
Athol	120	M 3
Aurora	202	R 5
Avance	10	E 4
Avon	692	N 8
Badger	180	P 5
Badnation	3	J 6
Baltic	255	R 6
Bancroft	100	O 4
Barnard	108	N 2
Batesland	88	E 7
Bath	90	N 3
Bear Butte	50	C 5
Beardsley	4	O 7
Beebe	4	L 3
Belle Fourche	3,540	B 4
Belvidere	172	G 6
Bemis	51	R 4
Benclare	15	R 6
Bend	5	D 5
Beresford	1,686	R 7
Berton	9	P 5
Betts	5	N 6
Big Springs	21	S 8
Big Stone City	829	S 3
Bijou Hills	35	L 6
Bison	457	E 2
Bixby	1	D 3
Black Hawk	91	C 5
Blackpipe		G 7
Blue Bell	4	C 6
Blue Range		O 7
Blunt	423	J 4
Bonesteel	485	M 7
Bonilla	90	N 4
Booge	10	R 6
Bovee	25	M 7
Bowdle	788	K 3
Box Elder	33	D 5
Bradley	226	O 3
Brandon	250	R 6
Brandt	211	R 4
Brave	2	J 6
Brentford	132	N 3
Bridger	5	E 4
Bridgewater	748	P 6
Bristol	647	O 3
Britton	1,430	O 2
Broadland	74	N 4
Brookings	7,764	R 5
Bruce	305	R 5
Bryant	624	P 4
Buffalo	380	B 2
Buffalo Gap	186	C 6
Bullhead	250	G 2
Bullock	5	B 2
Burbank	125	R 8
Burdette	6	M 4
Burdock	7	B 7
Burke	829	L 7
Burkmere	10	L 3
Bushnell	96	R 5
Butler	109	O 3
Cadillac	6	H 2
Camp Crook	122	B 2
Canistota	687	P 6
Canning		K 5
Canova	340	O 6
Canton	2,530	R 7
Capa	49	H 5
Caputa	30	D 5
Carpenter	75	O 4
Carter	16	J 7
Carthage	458	O 5
Cash	2	D 2
Castle Rock	11	B 4
Castlewood	498	R 4
Cavour	154	N 5
Cedar Canyon	3	D 3
Cedarbutte	5	H 6
Center	18	P 6
Center Point	10	P 7
Centerville	1,053	R 7
Central City	218	B 5
Chalkbutte	4	D 4
Chamberlain	1,912	L 6
Chance	16	E 3
Chancellor	193	R 7
Chelsea	41	M 3
Cherry Creek	140	F 4
Chester	200	R 6
Cheyenne Agency	450	J 3
Chilson		B 7
Claire City	109	P 2
Claremont	236	N 2
Clark	1,471	O 4
Clarno	2	P 6
Clayton	10	O 7
Clearfield	31	K 7
Clear Lake	1,105	R 4
Coal Springs	2	F 3
Colman	509	R 6
Colome	451	K 7
Colton	521	P 6
Columbia	270	N 2
Conata	50	E 6
Conde	409	N 3
Cooper	3	E 4
Corona	191	R 3
Corsica	551	N 7
Corson	49	R 6
Cottonwood	102	F 6
Crandall	35	O 3
Crandon	10	N 4
Craven	1	M 3
Creighton	5	E 5
Cresbard	235	M 3
Creston	10	D 6
Crocker	72	O 3
Crooks	120	R 6
Crow Lake	10	M 6
Custer	2,017	B 6
Cnthbert	14	N 6
Dahlberg	8	P 2
Dalesburg	35	P 8
Dallas	244	K 7
Dalzell	62	E 5
Danforth	10	M 5
Dante	140	N 7
Dark Canyon	50	C 5
Date	4	D 3
Davis	153	P 7
De Grey	6	K 5
De Smet	1,180	O 5
Deadwood	3,288	B 5
Deerfield	38	B 5
Dell Rapids	1,650	R 6
Delmont	405	N 7
Dempster	99	R 4
Denby	5	E 7
Dewey	40	A 6
Dimock	120	O 7
Dixon	25	L 7
Doland	535	N 4
Dolton	93	P 7
Dowling	9	F 5
Draper	252	J 6
Dumont	6	B 5
Dupree	438	F 3
Duxbury	5	M 3
Eagle	11	L 6
Eagle Butte	375	G 3
Eakin		K 4
East Mobridge	51	J 2
Eden	149	P 2
Edgemont	1,158	B 7
Edson	10	E 3
Egan	347	R 6
Elk Mountain		B 6
Elk Point	1,367	R 8
Elkton	657	S 5
Ellingson	4	D 2
Ellis	21	R 6
Elm Springs	7	D 5
Elmore	8	B 5
Elrod	37	O 4
Emery	480	O 6
Endlee	3	D 3
Englewood	16	B 5
Enning	20	E 4
Epiphany	40	O 6
Erskine	5	B 7
Erwin	153	P 5
Esmond	49	O 5
Estelline	760	R 4
Ethan	319	N 6
Eureka	1,576	K 2
Fairburn	80	C 6
Fairfax	301	M 7
Fairpoint		D 4
Fairview	155	R 7
Faith	599	E 4
Farmer	114	O 6
Farmingdale	19	D 6
Farwell	13	O 6
Faulkton	837	M 3
Fedora	125	O 5
Ferney	100	N 3
Firesteel	110	G 3
Flandreau	2,193	R 5
Florence	226	P 3
Foley	5	P 4
Folsom	2	D 6
Forest City	12	J 4
Forestburg	144	N 5
Fort Lookout		K 6
Fort Meade	860	C 5
Fort Pierre	951	H 5
Fort Thompson	225	L 5
Frankfort	331	N 4
Franklin	27	P 6
Frederick	408	N 2
Freeman	944	O 7
Fruitdale	70	B 4
Fullerville		P 8
Fulton	139	O 6
Gage	2	M 2
Galena	10	B 5
Gallup	6	N 3
Gannvalley	101	L 5
Garden City	282	O 4
Garretson	745	S 6
Gary	558	S 4
Gayville	271	P 8
Geddes	502	M 7
Gettysburg	1,555	K 3
Glad Valley	20	F 3
Glencross	30	H 3
Glenham	168	J 2
Goodwin	141	R 4
Gorman	6	K 4
Govert	10	C 3
Greenfield	22	R 8
Greenway		K 2
Greenwood	44	N 8
Gregory	1,375	L 7
Grenville	207	O 3
Gretna	2	L 3
Grosse	4	L 6
Groton	1,084	N 3
Grover	30	P 4
Gustave	2	B 3
Hamill	48	K 6
Hammer	77	R 2
Hanna	12	B 5
Hanton		P 4
Harding		B 3
Harrington	3	G 7
Harrisburg	274	R 7
Harrison	88	M 7
Harrold	263	K 4
Hartford	592	R 6
Hartley	1	F 5
Hay Creek		C 3
Haydraw	5	D 5
Hayes	30	H 4
Hayti	413	P 4
Hazel	161	P 4
Hecla	500	N 2
Henry	323	P 4
Heppner	3	B 7
Hereford	4	D 5
Hermosa	123	C 6
Herreid	633	K 2
Herrick	169	L 7
Hetland	123	P 5
Hidden Timber	12	J 7
Highmore	1,158	L 4
Hiland	5	P 3
Hill City	361	B 6
Hilland	5	F 5
Hillhead	100	O 2
Hillside	14	N 7
Hillsview	68	L 2
Hisega	15	C 5
Hisle	29	F 7
Hitchcock	227	M 4
Holabird	30	K 4
Holmquist	35	O 3
Hooker	30	R 7
Hoover	4	C 3
Hosmer	533	L 2
Hot Springs	5,030	C 7
Houghton	90	N 2
Hoven	552	K 3
Howard	1,251	P 5
Howes		E 4


SOUTH DAKOTA
SCALE OF MILES
0 5 10 20 40 60
State Capitals
County Seats
Railroads
A 104° B 30 C 103° D 30′ E 102° F 30′ G 101° H 30 J
1 2 3 4 5 6 7 8
46° 30′ 45° 30′ 44° 30′ 43° 30′
N O R T H
M O N T A N A
W Y O M I N G
N E B R A S K A
Baker
Amidon
Bowman
Mott
Carson
Cannonball
Cedar
Ft Yates
Missouri
STANDING ROCK
Hettinger
Grand
Spring Cr
Little Missouri R
Beaver
Boxelder
Karinen
Willett
Ladner
Ludlow
Ralph
Bullock
Buffalo
Camp Crook
Reva
H A R D I N G
Capitol
Harding
Gustave
Radig
Mason
Hoover
Hay Creek
North Fork
South Fork
Sand
Ellingson
Lodgepole
White Butte
Lemmon
Thunder Hawk
Morristown
Keldron
Watauga
McIntosh
Walker
Mapleleaf
Kenel
Shadehill
Shadehill Res
Whitedeer
Grand
C O R S O N
Bullhead
McLaughlin
Mahto
Wakpala
Little Eagle
Lightcap
Cash
Athboy
Bison
Meadow
Strool
Sorum
P E R K I N S
Coal Springs
Chance
Glad Valley
Oate
Antelope Cr
Endlea
Govert
Zeona
Moreau
Bixby
Thunder Butte
Rabbit
Firesteel
Isabel
Timber Lake
Glencross
Trail City
Promise
Whitehorse
D E W E Y
La Plant
Ridgeview
Cheyenne Agency
Mobridge
E Mobridge
Redelm
Dupree
Lantry
Eagle Butte
Parade
Flint Rock
Cedar Canyon
Maurine
Edson
Faith
Mud Butte
Castle Rock
B U T T E
Bentonite
Crow
Owl Cr
Indian
Arpan
Belle Fourche Reservoir
Belle Fourche
Fruitdale
Nisland
Newell
Vale
Willow Cr
Sulphur
Opal
Avance
Cooper
Z I E B A C H
Fairpoint
Stoneville
Redowl
Red Owl
Chalkbutte
Marcus
Howes
Whita Owl
Plainview
Bridger
Cherry Creek
Cheyenne
CHEYENNE RIVER
INDIAN RESERVATION
Mission Ridge
Okobojo
Union Center
Enning
Kirley
Sansarc
Oahe
Red Water
Beulah
Spearfish
St Onge
Whitewood
Sturgis
Fort Meade
Bear Butte
M E A D E
Haydraw
Hereford
Sundance
Tinton
Central City
Savoy
Trojan
Terry
Deadwood
Lead
Galena
Elmore
Englewood
Roubaix
Hanna
L A W R E N C E
Tilford
B L A C K H I L L S
Dumont
Nahant
Nemo
Piedmont
Elm Springs
Bend
Elk Creek
Viewfield
Pedro
Creighton
Hartley
Milesville
Cowling
Moenville
Manila
H A A K O N
Hilland
Ottumwa
Mitchell
S T A N L E Y
Hayes
Fort Pierre
Wendte
Van Metre
Black Hawk
Rochford
Silver City
Pactola
Rapid City
Box Elder
New Underwood
Wasta
Mystic
Hisega
Murphy
Redfern
Sheridan
Caputa
Owanka
Quinn
Wall
Cottonwood
Philip
Midland
Powell
Nowlin
Capa
J O N E S
Stamford
Okaton
Murdo
Draper
Cambria
Newcastle
Deerfield
Hill City
Rockerville
P E N N I N G T O N
Moon
Oreville
Keystone
Sylvan
Harney Pk
Hermosa
Farmingdale
Creston
Spring
Folsom
Scenic
BADLANDS NAT L MON
Conata
Interior
Wetaca
Kadoka
J A C K S O N
Belvidere
Westover
Jewel Cave Nat L Mon
Custer
Elk Mountain
Sanator
Blue Bell
Fairburn
C U S T E R
French
Battle
Cheyenne
Imlay
Pringle
Wind Cave National Park
Buffalo Gap
Beaver
Dewey
Hell Canyon
W A S H A B A U G H
(UNORGANIZED)
Potato Creek
Bear in the
Black Pipe
Wanblee
Cedarbutte
M E L L E T T E
White River
Wood
Burdock
Minnekahta
Erskine
Hot Springs
Fossil Cycad Nat L Mon
Chilson
Angostura Res
Oral
Rockyford
PINE RIDGE
Kyle
INDIAN RESERVATION
Longvalley
Wanamaker
Norris
Hisle
Edgemont
F A L L R I V E R
Smithwick
Heppner
Provo
Igloo
Black Hills Ordnance Depot
Rumford
Oelrichs
Horsehead
Ardmore
White
S H A N N O N
(UNORGANIZED)
Manderson
Oglala
Porcupine
Wounded Knee
Allan
Blackpipe
Patricia
Parmelee
B E N N E T T
Swett
Martin
Vetal
Tuthill
Harrington
Batesland
Oenby
Pine Ridge
Rosebud
T O D D
ROSEBUD INDIAN RESERVATION
St Francis
(UNORGANIZED)
Lakeview
Mission
Minnechaduza Cr
Valentine
Wayside
Rushville
Niobrara
Cherry
Bad
Cottonwood
Buffalo
Snake
Elm
Red Owl



100° K 30' L 99° M 30' N 98° O 30' P 97° R 30' S 96°
D A K O T A
Napoleon
Lisbon
James R.
Bois de Sioux
Fergus Falls
Edgeley
La Moure
Maple R.
Wahpeton
Breckenridge
Wild Rice R.
Monango
Oakes
Forman
Cogswell
Hankinson
Fairmount
Tintah
Hague
Ashley
Ellendale
Ludden
Forbes
Greenway
Longlake
Long L.
Winship
Frederick
Hecla
Newark
Kidder
Marlow
Veblen
Ohlberg
Victor
New Effington
White Rock
Rosholt
Claire City
Hammer
Wheaton
Britton
Hillhead
Muslinka R.
Eureka
MC PHERSON
Leola
Barnard
Houghton
Sand L.
MARSHALL
Amherst
Lake City
Spain
Buffalo L.
Eden
L. Traverse
Sisseton
Browne Valley
Hillsview
Wetonka
Westport
Gage
BROWN
Claremont
Hecla
Ordway
Columbia
Hufton
Langford
ROBERTS
Dry Wood L.
Peever
Graceville
Big Stone L.
Hosmer
Richmond
Putney
Plana
Tacoma Park
Pierpont
Grenville
Roslyn
L. Parker
Java
Gretna
Roscoe
Ipswich
Mina
Aberdeen
Bath
James
Groton
Andover
Waubay L.
Wilmot
Whetstone
Corona
WALWORTH
Bowdle
Beebe
Craven
EDMUNDS
Mansfield
DAY
Webster
Waubay
Ortley
Summit
Big Stone City
Ortonville
Appleton
Lowry
Rudolph
Stratford
Ferney
Bristol
Holmquist
Marvin
Milbank
Minnesota R.
Warner
Loyalton
Randolph
Verdon
Butler
Prairie L.
Twin Brooks
Hiland
GRANT
Hoven
Tolstoy
Onaka
Norbeck
Wecota
Chelsea
Cresbard
Mansfield
Brentford
Conde
Crandall
Lily
South Shore
Stockholm
La Bolt
Nassau
Northville
Mellette
Adelaide
Swan L.
Wallace
Albee
Marietta
POTTER
FAULK
Gallup
Turton
Crocker
Bradley
Dry L.
Florence
Troy
Strandburg
Revillo
Madison
Lebanon
Seneca
Burkmere
Faulkton
Athol
Ashton
Reid L.
Rauville
Waverly
Gettysburg
Miranda
CODINGTON
SPINK
Doland
Garden City
L. Kampeska
Kranzburg
Goodwin
Zell
Raymond
Henry
Watertown
Hanton
Bemis
Altamont
Moritz
Orient
Rockham
Clark
Elrod
Kampeska
Grover
Foley
Appleby
DEUEL
Gary
Redfield
Frankfort
CLARK
Thomas
Clear Lake
Crandon
Naples
Hazel
Castlewood
Cottonwood L.
Tulare
HAMLIN
Big Sioux R.
Hayti
Dempster
Brandt
Lac qui Parle R.
Turdette
Ladelle
Vienna
Poinsett
Carpenter
Estelline
Toronto
Astoria
Wolf Cr.
Spottswood
Hitchcock
Willow Lake
Bryant
Lake Norden
L. Poinsett
Ivanhoe
HYDE
HAND
Bonilla
L. Byron
Melham
Holabird
Highmore
Miller
St. Lawrence
Broadland
Bancroft
Spirit
Erwin
Badger
White
Harrold
Ree Heights
Vayland
Wessington
Yale
Iroquois
De Smet
Lake Preston
Bruce
BROOKINGS
Wolsey
Manchester
Hetland
Arlington
Volga
Bushnell
BEADLE
KINGSBURY
Ahnberg
Brookings
L. Benton
Tyler
HUGHES
Huron
Cavour
Lake Thompson
Esmond
Sinai
Aurora
Elkton
De Grey
Virgil
Mathews
Oldham
Stephan
CROW CREEK INDIAN RESERVATION
Danforth
Nunda
Ward
Crow Creek
Carthage
Berton
Ramona
Rutland
Alpena
Templeton
Wessington Springs
Woonsocket
Argonne
Nansen
LAKE
Flandreau
MOODY
BUFFALO
JERAULD
SANBORN
MINER
Howard
Madison
Wentworth
Egan
Pipestone
LOWER BRULE INDIAN RESERVATION
Lower Brule
Fort Thompson
Gannvalley
Lane
Fedora
Herman L.
Junius
Colman
Forestburg
Artesian
Roswell
Vilas
Winfred
L. Madison
Brant L.
Chester
Trent
Fort Lookout
Crow Lake
Cuthbert
Farwell
Clarno
Franklin
Dell Rapids
LYMAN
Kennebec
Reliance
Grosse
Smith Cr.
Storla
Letcher
Canova
Epiphany
Center
Unityville
Colton
Baltic
Sherman
Garretson
Oacoma
Chamberlain
Pukwana
Lyonville
White L.
Loomis
Mount Vernon
Mitchell
Rock Cr.
Farmer
Salem
Lyons
MINNEHAHA
Kimball
White Lake
Plankinton
Betts
Fulton
HANSON
Spencer
MC COOK
Montrose
Crooks
Renner
Corson
Beaver Creek
Luverne
BRULE
AURORA
DAVISON
Alexandria
Emery
Humboldt
Hartford
Brandon
Valley Springs
Hamill
Ideal
Platte L.
Stickney
Ethan
Canistota
Ellis
SIOUX FALLS
Rowena
Eagle
Robey
Bridgewater
South Sioux Falls
Iona
Bijou Hills
Blue Range
Dolton
Monroe
Shindler
Lester
Academy
Hillside
Harrison
Corsica
Clayton
Marion
Chancellor
Tea
Harrisburg
Winner
Olson
Joubert
New Holland
DOUGLAS
Milltown
Parkston
Freeman
Parker
Lennox
Worthing
Canton
Platte
Bovee
Armour
HUTCHINSON
TURNER
Hurley
LINCOLN
TRIPP
Colome
Dallas
GREGORY
Lucas
Gregory
Burke
Delmont
Geddes
L. Andes
Olivet
Menno
Center Point
Davis
Hooker
Fairview
Rock Valley
Randall Reservoir
Tripp
Kaylor
Scotland
Midway
Viborg
Centerville
Hudson
Clearfield
Herrick
Keyapaha
Millboro
Wewela
Paxton
W. Carlock
St. Charles
Bonesteel
Fairfax
CHARLES MIX
Lake Andes
Ravinia
Pickstown
Wagner
Dante
FT. RANDALL DAM
BON HOMME
Tyndall
Lesterville
YANKTON
Irene
Wakonda
Alcester
Beresford
Hawarden
Anoka
Marty
Avon
Tabor
Utica
Janousek
Volin
Mission Hill
Dalesburg
Alsen
Nora
Big Springs
CLAY
UNION
Butte
Greenwood
Kingsburg
Lakeport
Yankton
Gayville
Meckling
Spink
Centerville
Vermillion
Richland
Weatfield
Merrill
Perkina
Springfield
Missouri R.
Burbank
Springview
Niobrara R.
Running Water
Niobrara
N E B R A S K A
Crofton
Wynot
Elk Point
Jefferson
McCook
Hartington
Ponca
North Sioux City
Sioux City
Center
Bloomfield
Bassett
Ainsworth
Wausa
Laurel
Dakota City
Randolph
Plainview
Elkhorn R.
M I N N E S O T A
I O W A
1 2 3 4 5 6 7 8
46° 45° 44° 43°
30'
Copyright by C. S. Hammond & Co., N. Y.
2571
Long. West 100° of Greenwich K 30' L 99° M 30' N 98° O 30' P 97° R 30' S

SOUTH DAKOTA—*Continued*

Hudson	500	R 7
Huffton	17	N 2
Humboldt	450	P 6
Hurley	474	P 7
Huron	12,788	N 5
Ideal	10	K 6
Igloo	1,920	B 7
Imlay	3	E 6
Interior	126	F 6
Iona	17	L 6
Ipswich	1,058	L 3
Irene	374	P 7
Iroquois	413	O 5
Isabel	511	G 3
James	8	N 3
Janousek		O 8
Java	433	K 3
Jefferson	466	S 8
Joe Creek	56	K 5
Joubert	20	M 7
Junius	30	P 6
Kadoka	584	F 6
Kampeska	16	P 4
Karinen	1	B 2
Kaylor	175	O 7
Keldron	10	F 2
Kenel	129	H 2
Kennebec	374	K 6
Keyapaha	19	J 7
Keystone	600	C 6
Kidder	146	O 2
Kimball	952	M 6
Kingsburg	11	O 8
Kirley	5	G 4
Kranzburg	135	R 4
Kyle	89	E 7
La Bolt	164	R 3
La Plant	100	H 3
Ladelle	5	N 4
Ladner	10	B 2
Lake Andes	1,851	M 7
" City	110	O 2
" Norden	373	P 4
" Preston	957	P 5
Lakeport		O 8
Lakeview	16	H 7
Lane	145	N 5
Langford	456	O 2
Lantry	26	G 3
Lead	6,422	B 5
Lebanon	215	K 3
Lemmon	2,760	E 2
Lennox	1,218	R 7
Leola	772	M 2
Lesterville	192	O 7
Letcher	291	N 6
Lightcap	2	G 2
Lily	139	O 3
Little Eagle	575	H 2
Lodgepole	30	D 2
Longlake	175	L 2
Longvalley	10	F 7
Loomis	67	N 6
Lower Brule	162	K 5
Lowry	70	K 3
Loyalton	57	L 3
Lucas	25	L 7
Ludlow	6	C 2
Lyman	16	K 6
Lyons	77	R 6
Lyonville		M 6
Madison	5,153	P 6
Mahto	55	H 2
Manchester	40	O 5
Manderson	110	D 7
Manila	5	G 5

Mansfield	200	M 3
Mapleleaf		H 2
Marcus	11	E 4
Marion	794	P 7
Marlow	8	P 2
Martin	989	F 7
Marty	600	N 8
Marvin	110	R 3
Mason	1	B 3
Mathews		P 5
Maurine	11	E 3
McCook	300	S 8
McIntosh	628	G 2
McLaughlin	713	H 2
Meadow	37	E 2
Meckling	111	R 8
Melham		O 4
Mellette	250	N 3
Menno	868	P 7
Midland	387	G 5
Midway	15	P 7
Milbank	2,982	R 3
Milesville	19	F 5
Millboro	33	K 7
Miller	1,916	L 4
Milltown	39	O 7
Mina	46	M 3
Minnekahta	6	B 7
Miranda	79	M 4
Mission	388	H 7
Mission Hill	169	P 8
Mission Ridge	2	H 4
Mitchell	12,123	N 6
Mobridge	3,753	J 2
Moenville	4	G 5
Monroe	160	P 7
Montrose	448	P 6
Moon	4	B 6
Morefield	7	R 6
Moritz	16	S 4
Morristown	190	F 2
Mosher	18	J 7
Mossman	7	H 3
Mound City	177	K 2
Mount Vernon	387	N 6
Mud Butte	16	D 4
Murdo	739	H 6
Murphy	10	C 5
Mystic	40	B 5
Nahant		B 5
Nahon	4	N 3
Nansen	2	O 5
Naples	62	O 4
Nemo	100	B 5
New Effington	367	R 2
New Holland	125	M 7
New Underwood	268	D 5
New Witten	198	K 7
Newark	80	O 2
Newell	784	C 4
Nisland	216	C 4
Nora	10	R 8
Norbeck	16	L 3
Norris	111	G 7
N. Sioux City	300	R 8
Northville	220	M 3
Nowlin	20	G 5
Nunda	102	P 5
Oacoma	231	L 6
Oahe	32	J 5
Oelrichs	168	C 7
Oglala		D 7
Okaton	137	H 6
Okobojo	2	J 4

Okreek	260	J 7
Oldham	349	P 5
Olivet	202	O 7
Onaka	158	L 3
Onida	822	K 4
Opal	50	D 4
Oral	100	C 7
Ordway	6	N 2
Oreville		B 6
Orient	206	L 4
Ortley	144	P 3
Osceola	37	O 5
Ottumwa	4	G 5
Owanka	50	D 5
Pactola	85	C 5
Parade	8	G 3
Parker	1,148	P 7
Parkston	1,354	O 7
Parmelee	116	G 7
Patricia	10	G 7
Paxton	11	L 7
Pedro	19	E 5
Peever	221	R 2
Perkins	14	O 8
Philip	810	F 5
Pickstown	2,217	M 7
Piedmont	200	C 5
Pierpont	326	O 3
PIERRE	5,715	J 5
Pine Ridge	2,000	E 7
Plainview	7	E 4
Plana	15	N 2
Plankinton	754	N 6
Platte	1,069	M 7
Poinsette	50	P 4
Pollock	395	J 2
Porcupine	25	E 7
Potato Creek	8	F 6
Powell	15	G 5
Presho	712	J 6
Pringle	193	B 6
Promise	7	H 3
Provo	100	B 7
Pukwana	302	L 6
Putney	14	N 2
Quinn	214	E 5
Ralph	2	C 2
Ramona	278	P 5
Randolph	29	N 3
Rapid City	25,310	C 5
Rauville	8	P 3
Ravinia	200	N 7
Raymond	174	O 4
Redelm	6	F 3
Redfern		B 5
Redfield	2,655	N 4
Redig	10	C 3
Redowl	11	D 4
Ree Heights	254	L 4
Reliance	215	K 6
Renner	99	R 6
Reva	6	C 2
Revillo	249	R 3
Richland	30	R 8
Richmond	7	M 2
Ridgeview	60	H 3
Robey	100	M 6
Rochford	50	B 5
Rockerville	30	C 6
Rockham	113	M 4
Rockyford	11	E 7
Roscoe	726	L 3
Rosebud		H 7
Rosholt	387	R 2
Rosyln	222	P 2
Roswell	69	O 6

Roubaix		B 5
Rouseau	41	K 5
Rowena	70	R 6
Rudolph	4	N 3
Rumford	8	B 7
Running Water	23	O 8
Rutland	100	P 5
Saint Charles	50	L 7
Saint Francis	241	H 7
Saint Lawrence	261	M 4
Saint Onge	104	B 4
Salem	1,119	P 6
Sanator	251	B 6
Sansarc	4	H 5
Savoy	16	B 5
Scenic	75	D 6
Scotland	1,188	O 7
Selby	706	J 3
Seneca	204	L 3
Shadehill	21	E 2
Sheridan	8	C 5
Sherman	120	S 6
Shindler	50	R 7
Silver City	35	B 5
Sinai	181	P 5
Sioux Falls	52,696	R 6
Sisseton	2,871	R 2
Smithwick	100	C 7
Sorum	3	D 3
South Shore	269	P 3
South Sioux Falls	1,586	R 6
Spain		O 2
Spearfish	2,755	B 5
Spencer	552	O 6
Spink	41	R 8
Spottswood		M 4
Springfield	801	N 8
Stamford	10	G 6
Stephan	150	K 5
Stickney	388	M 6
Stockholm	114	R 3
Stoneville	5	D 4
Storla	36	M 6
Strandburg	144	R 3
Stratford	164	N 3
Strool	75	D 3
Sturgis	3,471	B 5
Sulphur	3	D 4
Summit	431	P 3
Swett	12	E 7
Sylvan Lake		B 6
Tabor	373	O 8
Tacoma Park	15	N 2
Tea	151	R 7
Templeton	5	M 5
Terry	70	B 5
Thomas	37	P 4
Thunder Hawk	82	F 2
Tilford	85	C 5
Timber Lake	552	H 3
Tinton	10	A 5
Tolstoy	180	K 3
Toronto	322	R 4
Trail City	200	H 3
Trent	213	R 6
Tripp	913	N 7
Trojan	200	B 5
Troy	44	R 3
Tulare	212	N 4
Turton	201	N 3
Tuthill	50	G 7
Twin Brooks	113	R 3
Tyndall	1,292	O 8
Union Center	10	D 4
Unityville	85	P 6

Utica	84	P 8
Vale	152	C 4
Valley Springs	389	S 6
Van Metre	10	H 5
Vayland	24	M 5
Veblen	476	P 2
Verdon	34	N 3
Vermillion	5,337	R 8
Vetal	38	G 7
Viborg	644	P 7
Victor	35	R 2
Vienna	306	O 4
Viewfield	3	D 5
Vilas	71	O 6
Virgil	124	N 5
Vivian	250	J 6
Volga	578	R 5
Volin	197	P 8
Wagner	1,528	N 7
Wakonda	454	P 7
Wakpala	350	H 2
Walker	27	G 2
Wall	556	E 6
Wallace	188	P 3
Wanamaker	5	G 7
Wanblee	325	F 6
Ward	96	R 5
Warner	115	M 3
Wasta	144	D 5
Watauga	96	G 2
Watertown	12,699	P 4
Waubay	879	P 3
Waverly	50	R 3
Webster	2,503	P 3
Wecota	40	L 3
Wendte	40	H 5
Wentworth	270	R 6
Wessington	467	M 5
Wessington Springs	1,453	M 5
West Britton		O 2
West Carlock	3	L 7
Westerville	17	P 8
Westover	2	H 6
Westport	116	M 2
Weta		F 6
Wetonka	115	M 2
Wewela	29	K 7
White	525	R 5
White Butte	154	E 2
White Lake	395	M 6
White Owl	19	E 4
White River	465	H 6
White Rock	133	R 2
Whitedeer		F 2
Whitehorse	67	H 3
Whitewood	304	B 5
Whitlocks Crossing	23	J 3
Willett		B 2
Willow Lake	484	O 4
Wilmot	590	R 3
Winfred	171	P 6
Winner	3,252	K 7
Winship	6	M 2
Wist	8	P 2
Witten		J 7
Wolsey	391	N 5
Wood	260	J 6
Woonsocket	1,051	N 5
Worthing	272	R 7
Wounded Knee	150	D 7
Yale	164	O 5
Yankton	7,709	P 8
Zell	95	M 4
Zeona	2	D 3

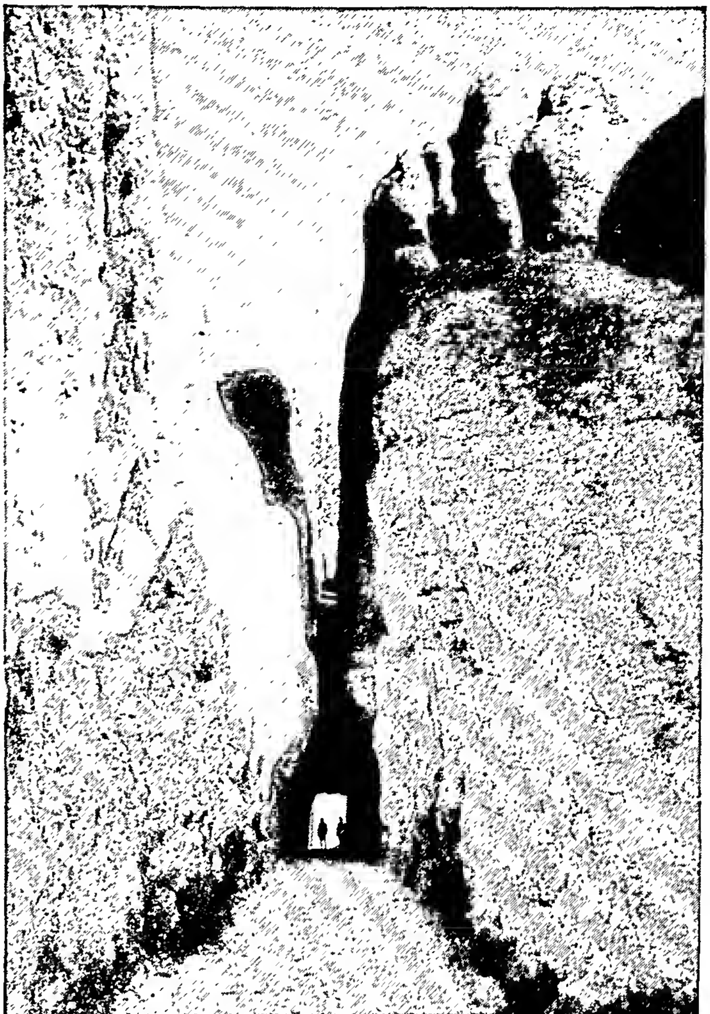
many bloody battles. Most famous was the massacre of Custer and his men in the Little Bighorn country in nearby Montana. (*See also* Indians; Montana.)

For ten years after the discovery of gold, stagecoaches and wagons were the chief means of transportation in the Black Hills. Then in 1885 the Chicago and Northwestern Railway extended its line northward from Chadron, Neb., to Buffalo Gap. From here stage lines carried mail, provisions, and prospectors to new gold strikes. Deadwood boomed as a mining town. Such colorful characters as Wild Bill Hickok and Calamity Jane lived here. It was also the reputed home of Deadwood Dick, fictitious hero of dime novels.

The Homestake Mine is now the largest producing gold mine in the United States. Crushed ore is shipped to nearby Lead for processing. Gold is also mined in small quantities elsewhere in the Black Hills. Its annual production is about one half of all South Dakota minerals.

The second mineral in value is stone. It is mined chiefly in the Black Hills and in the east. Other products mined are sand and gravel, clays, feldspar, silver, beryllium concentrate, lignite coal, lead, mica, natural gas, tantalum concentrate, zinc, cement, lime, and lithium minerals.

A SOUTH DAKOTA SCENIC HIGHWAY



This tunnel on the picturesque Needles Highway was blasted through solid rock. Every year thousands of touring visitors view this and many other curious rock formations in Custer State Park in the Black Hills.

Agricultural Wealth

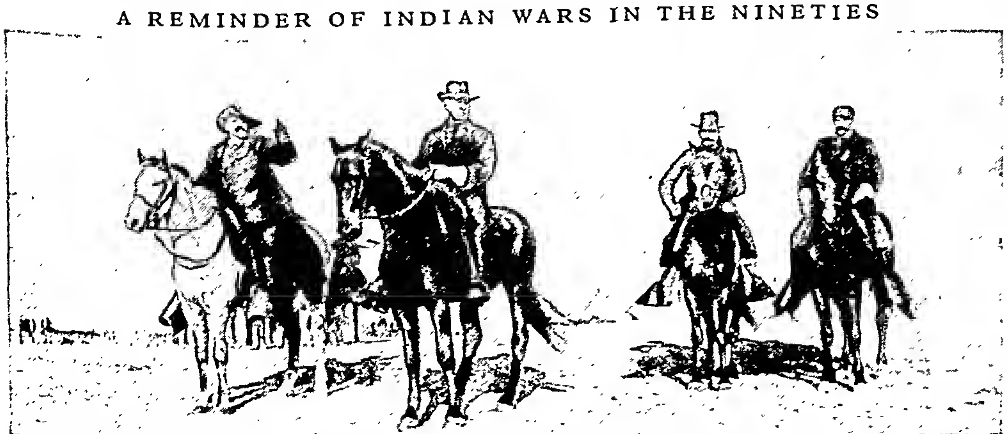
South Dakota is essentially a farm state. More of its people are engaged in farming than in any other occupation. The annual income from farm products is many times greater than all its manufactures and minerals combined. Corn is the leading crop. Most of it is used on the farms as feed for South Dakota's cattle and hogs. The state is also an important producer of other grains such as wheat, oats, and barley.

The population of South Dakota is predominantly rural. Only six cities have more than 10,000 inhabitants—Sioux Falls, Rapid City, Aberdeen, Huron, Watertown, and Mitchell. They are trading centers for near-by farm areas. Their chief industries are those that process farm products, especially meat packing and butter making. Other South Dakota communities started years ago as fur-trading posts.

Most of the early explorers sought to buy furs from the Indians (for territorial history, *see* North Dakota). In 1811 Wilson Price Hunt and his men pushed up the Missouri and then the Grand River. They were on the way west to open John Jacob Astor's great trading post at the mouth of the Columbia River. Astor's chief rival for the fur trade with the Indians in the Dakotas was the explorer Manuel Lisa.

Lisa's influence with the Indians was so great that he was able to bring the Sioux back home from the

A REMINDER OF INDIAN WARS IN THE NINETIES



Buffalo Bill (Colonel Cody), Gen. Nelson A. Miles, Capt. Frank Baldwin, and Capt. Marion P. Maus view a hostile Indian camp near Pine Ridge, S. D.

siege of Fort Meigs, Ohio, where they were aiding the British in the War of 1812.

Hardships of the Early Settlers

Settlers came slowly at first into this Indian country. Pioneers following the lure of the rich farm lands entered the country in ox-drawn prairie schooners or on river boats which plied far up the streams to rolling plains and beckoning hills.

Hardship was sometimes followed by tragedy when these brave settlers were driven away or massacred by Indians, their livestock slaughtered and their homes burned. More peaceful times, after the coming of the railway and the discovery of gold in the Black Hills by Colonel Custer's expedition, brought settlers during the "Great Dakota Boom" from 1877 to 1885. Yankton, the site of a Yankton Indian village, was established as a permanent trading post in 1858. It was the capital of Dakota Territory until 1883. Scandinavians, Germans, and Russians joined with easterners and helped to open up the territory. Today foreign born make up only a small portion of the population; a larger number are of foreign-born or mixed parentage.

WHERE HISTORY HAS BEEN CARVED IN STONE

Mount Rushmore National Memorial stands in South Dakota's Black Hills near Keystone. This "shrine to democracy" is a monument to the building of America. It is a colossal sculpture carved by Gutzon and Lincoln Borglum from the granite face of Mount Rushmore, 6,000 feet high. Giant busts (left to right) of Washington, Jefferson, Theodore Roosevelt, and Lincoln commemorate the founding, expansion, unification, and preservation of the nation. Each face is about 60 feet high. The faces can be distinguished from a distance of about 17 miles. The work is the largest sculpture ever carved.

The pioneers took up homesteads or bought farms from the land companies and began building their one-room homes and tilling the soil.

Grueling hardships faced them. First there were Indian troubles, then six years of grasshopper plague, ending in 1876. The early autumn snows of 1880 were followed by the spring floods of 1881. Next came the raging blizzard of 1883 and finally searing droughts. Farming methods which had been successful in the settlers' foreign homes failed on the prairie. Some gave up the struggle, but most of these hardy folk learned the ways of the new land and built prosperous farms.

The School System of South Dakota

The early settlers desired educational and religious advantages for their families The government had set aside two sections of each township for a territorial school fund. In 1879 it was rumored that speculators were to buy this land cheaply. Public-spirited citizens fought the sacrifice of school lands

A GLIMPSE OF THE VANISHING OPEN RANGE

A generation ago herds of cattle everywhere roamed the open range in the western part of South Dakota, but now herds as large as this one, brought to water in the Bad River near Pierre, are not so common. The range has been broken up by settlement, and the homesteader's fence has long since restrained the cowboy and his herds.

and started a movement to divide Dakota territory into two states. General W. H. H. Beadle, the territorial superintendent of public instruction, protected the educational interests. He made certain that the constitution of the new state and the act of Congress admitting the state to the Union in 1889 forbade the school lands to be sold for less than $10 an acre.

Dr. Joseph Ward organized Yankton Academy in 1872. In 1881 he founded Yankton College, the first college in Dakota territory. The University of South Dakota at Vermillion was created in the territory in 1862 and opened in 1882. South Dakota State College of Agriculture and Mechanic Arts at Brookings was founded in 1883. The South Dakota School of Mines and Technology was established at Rapid City in 1887.

Private schools in the state besides Yankton College are Huron College at Huron, Dakota Wesleyan University at Mitchell, and Sioux Falls College and Augustana College at Sioux Falls.

Money from sale or lease of public lands is used for public schools. Few states have a smaller proportion of illiteracy. South Dakota was the first state to adopt initiative and referendum (1898).

Missouri River Basin Project

South Dakota is part of the vast development program in the Missouri River basin (*see* Missouri River). Ten states will benefit by power, irrigation, and flood control. The Missouri River's worst flood in 1952 showed the urgent need for flood control.

Four great dams will be on the Missouri in South Dakota. Oahe will back up the river from near the capital into North Dakota. Gavins Point Dam near Yankton is under way. Big Bend Dam is also proposed near Chamberlain. Fort Randall, one of the world's earth-fill dams, is near the Nebraska line. It began producing power in 1954. (*See also* chronology in South Dakota Fact Summary; United States, sections "North Central Plains" and "Great Plains.")

How SPAIN WON *and* LOST *the* AMERICAN SOUTHWEST

Something of the spirit of the great Southwest, its wide expanses of sky, the natural ruggedness of its beauty, and the romantic character of its past, has been captured in this scene from the Universal photoplay, 'Crimson Days'.

SOUTHWEST, AMERICAN. El Camino Real (The King's Highway) extends from the great warm harbor at San Diego to the bluff on the peninsula that overlooks the Golden Gate of San Francisco Bay. Threaded along its course, the walls of adobe missions still stand. These are reminders of the day when there was a "golden age" in California, and when Franciscan friars, risking their lives, carried the gospel to the farthest frontiers of this great stretch of land called New Spain.

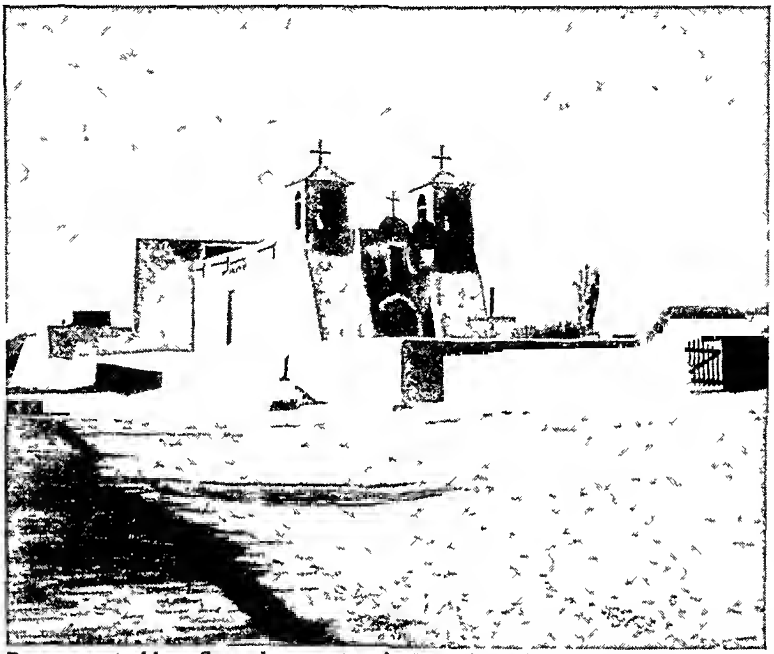
In the year in which the Continental Congress in Philadelphia (1776) declared the independence of the colonies from England, the Spanish thrust reached its last outpost in the mission and *presidio* (fort) of San Francisco. No one knew that the empire of Spain was near the end of its greatness, and that in the hall of the State House in Philadelphia was beginning an empire marked by destiny to drive the Spanish south of the Rio Grande and the Sierra Nevada.

When Antonio de Mendoza came out in 1535 as first viceroy of New Spain, the northern borders of his domain extended to two great deserts. Through one of these the Rio Grande wandered to the Gulf of Mexico. Along the northern and western sides of the other the Colorado cut its way down from the high Rockies to sea level on the Gulf of California. For more than 200 years Spain took little interest in this land to the north, planting a few small villages where there was water and collecting information about the country beyond the border. De Soto, Cabeza de Vaca, Coronado, and Cabrillo, in a few years after the vice-royalty was set up, looked over the land and brought home discouraging reports of its value.

From the wanderings of Cabeza de Vaca along the northern shore of the Gulf of Mexico came rumors told by Indians of cities of gold somewhere in the interior. These could not be verified, yet they kindled the hope of discovering mines like those of Mexico

and Peru. De Soto (1539–42) tramped from Florida to the Mississippi in a vain search for easy wealth. Coronado, from a port on the west coast of Mexico, made a journey (1540–41) around the Sonora Desert and the valley of the Rio Grande, and continued east into central Kansas, with the golden cities always just a day's march ahead. Cabrillo (1542), lured by the tales, sailed northward, found at San Diego a harbor, but never reached the fabled cities. (*See* America)

THE SPIRIT OF THE SOUTHWEST



Reminiscent of long Spanish occupation is this old mission church at Ranchos de Taos, New Mexico, located on the "Indian detour," a trail arranged to show tourists leading points of interest.

In the years that followed the northern frontier was left to casual explorers and indomitable missionaries, while the greater folk of Spain devoted their time and labor to regions where profit was certain to be found. The seemingly endless trail to the northwest began at Vera Cruz and was soon well marked across unhealthful flats and up slopes as far as Mexico City. From the capital city, the trail pushed northward, becoming as it advanced less and less easy for the rough bullock carts that carried freight.

Half a century after the grand tour of Coronado, a colony was founded in the upper valley of the Rio Grande, at the northern end of the main highway. Here the river, which rises in the Rockies, flows southward between two parallel ranges of mountains, with fertile grassy plains on either side. This is New Mexico. Santa Fe, founded in 1609, where a few ranchers, priests, and soldiers lived, had almost no contact with the outside world, until Zebulon Montgomery Pike wandered along in 1807. In 1821 overland trade with the Missouri border brought the settlements into touch with the United States.

Trails in the Wilderness

East and west from the main road, branches turned off to other outposts. One of them crossed the Rio Grande at the mission of San Juan Bautista, leading to the French station at Natchitoches on the Red River. San Antonio, founded in 1718, became a center for sparse occupation of the plains of eastern Texas. The other branch road swung westward to the valley of the Gila River and the Gulf of California.

While the Texas stations were being planted to the east, Jesuit missionaries were moving westward through Sonora toward Arizona and southern California (*see* Arizona; New Mexico). Father Eusebio Kino was the most notable among these for more than 20 years. Before his death in 1711, a chain of churches reached along the new frontier to the Colorado River. The costs of his expeditions were borne by contributions from the faithful, for Spain was too poor to pay them out of her treasury; and the missions generally had to be self-supporting. No great enterprises were developed to tempt investors, although a few silver mines were opened in Arizona.

The Indians, converted to Christianity, cultivated the fields and tended stock on the ranches, and the missionary fathers taught the tribesmen not only religion but also farming and the needed crafts, such as carpentry and leather-working. Too far away for supplies from Spain, and with no exports, the Spanish missions and ranches, whether in Texas, New Mexico, Sonora, or Lower California, knew only a stagnant, simple life.

Dangers from the North

The Seven Years' War, which is known in America as the French and Indian War, brought England on the scene as a danger to Spanish control in the Southwest. Hitherto the rough settlements of English colonists were generally east of the Appalachians, and between them and the Spanish outposts was Louisiana, the domain of France. The most successful of the struggling French colonies were far away in the St. Lawrence Valley and offered no threat to the Southwest. New Orleans, near the Mississippi's mouth, had not prospered. However, the Treaty of Fontainebleau in 1762 brought changes. Spain was forced to surrender Florida and received from France the western half of the Louisiana region. This was not a desirable acquisition for Spain because it was far from its settlements in New Mexico. Spain, nevertheless, held the territory to protect Texas and Mexico from possible English pressure.

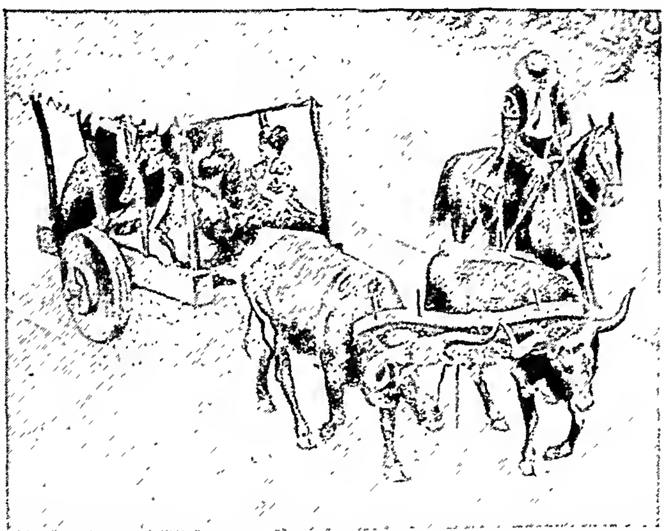
Shortly after 1763, the Spanish king Charles III sent José de Galvez, an energetic and honest agent, to New Spain to reform its government He organized the northern settlements under the name of Interior

Provinces, strengthened the frontier posts to resist better foreign pressure, and set up a new front line towards the Colorado River to protect Lower California and Sonora. Rumors reached him that dangers might come both from the English on the northeast and from the Russians on the northwest. Russian fur traders, who crossed to North America from Siberia, had reached Alaska, and were pushing down toward San Diego, which the Spanish had not occupied.

Galvez visited Lower California, as the country south of San Diego Bay was called, and then determined to establish a chain of stations in Alta California, the present state of California. He proposed to take the country with a fleet sent north from Mexico, and an army marched overland from Lower California. The Bay of Monterey, which had been discovered by Sebastian Vizcaino on his voyage of exploration (1602–03) he decided to hold for the king of Spain.

In 1769 the work began with the erection of a fort and a mission at San Diego. The greatest of the California missionaries, Father Junipero Serra, devoted his life to the conversion of the Indians and the organization of mission colonies (*see* California). The soldier, Gaspar de Portola, built a fort at San Diego, and then led his men north along the coast. Before the summer ended, he came by chance to an unknown inland sea, later called the Bay of San Francisco. The value of this bay as a harbor and as a strategic point from which to control a large country was clear at once. Here *El Camino Real* ended, though seven years passed before the actual occupation of the presidio of San Francisco took place, since the chain of forts had to be advanced a link at a time from the military base at San Diego.

SPANISH DAYS LIVE AGAIN



This old ox-cart of 150 years ago, used in an Old Spanish Days Fiesta at Santa Barbara, Calif., is typical of the quiet simplicity of life in the "Golden Age" of California.

The Golden Age in California

The Grand Canyon of the Colorado River, now a great national park, was a calamitous obstacle for the Spanish, intent on defending New Spain, because the yawning depths of its great chasm were almost impassable barriers to California by land (*see* Grand Canyon). Within a few years after the building of the missions, the country between Santa Fe and San Francisco was explored in the hope of finding a satisfactory route. In 1774 the Spanish explorer Juan Bautista de Anza crossed from Sonora by way of the Gila River. Father Francisco Garcés, a Franciscan friar, broke a trail from Santa Fe, which crossed the Colorado at the Needles, a few miles below the point where the boundaries of the present states of Arizona and California meet, and continued west by way of the Mohave Desert. However, these routes were too rough for common travel; indeed, no good way to California was found, and the villages here, like those elsewhere on the northern frontier, were forced to be self-sufficient.

Yet, California, though hard to reach, was a land of happiness. Its gentle climate and fertile soil made life comfortable without much hard work. Adobe churches, from which Spanish influence spread among the Indians, were built to resemble those of Spain—as much as churches of mud could look like those of stone. Within their heavy walls the resemblance was even more marked, for gifts of paintings, silver ornaments, and carved wood decorated altars and walls. Near the churches were the villages of the Indians, for whom conversion meant both harder work and more certain living than they had known.

The building of a presidio alongside a mission, as was often necessary for protection in the early years, brought soldiers, who purchased the produce of Indian farms and hired Indian servants. Most of the soldiers came to California unmarried. When their periods of enlistment ended, many took Indian wives and built homes near the missions. They and their children became farmers and ranchers. Some of them acquired far-reaching estates, where they lived in patriarchal style—in mud houses, to be sure, but with great herds and plenty of the simple things of life. They lacked most of the ordinary manufactured goods, but they had a few luxuries, such as silverware and jewels, and they imported satins and laces from Spain.

Another feature of the Spanish civilization was the *pueblo*, or non-military town, founded by the Spanish. Since the Spanish colonies had none of the easy emigration that filled the English colonies with working settlers, groups of families were sometimes sent to the frontier to found villages, which grew slowly, but steadily. For about 50 years, the new frontier remained outside the currents of active trade and foreign contact. Spain made every effort to keep the colonies in isolation, and only the separation of Mexico from Spain in 1821 broke down the barriers.

"Manifest Destiny"

From the presidio on San Francisco Bay to the fort at Nacogdoches, at the head of the Sabine River, the far-flung northern frontiers of New Spain were in

their "golden age" when Jefferson in 1803 bought Louisiana from France. Then, almost in a moment, the picture changed once more. What Spain could never do, the United States could not prevent. The efforts of missionaries and colonists had hardly scratched the soil. Over all the country between the Mississippi River and the Pacific Ocean, there were only a few scattered homes and towns of white men. "New Spain" was merely a name—a false name, indeed, for "Old Spain" had stayed at home. There was little of that transfer of a civilization, piece by piece, and man by man, which had made New England and Virginia into the domain of sturdy British folk. However, when the call of home-seeking that converted English colonists into Americans lured pioneers to the West, new states ripened down the Ohio Valley and along the Mississippi. Then it was that so-called "manifest destiny" drove the American frontier into victorious clash against the Spanish. (*See* United States History.)

Americans began pouring into the Interior Provinces of Spain in 1820–30. Into Texas came Stephen Austin, leading Mississippi and Tennessee backwoodsmen, not to make war against Mexico, but to seek homes. Others followed, and long before Americans were as numerous as the Mexicans among whom they settled, it was clear that nothing could change their devotion to the Union. Before Jackson left the White House, they had established an independent republic and shortly (1845) entered the Union. (*See* Texas.)

Into New Mexico, after 1821, marched annual processions of Santa Fe traders. Their covered wagons carried stocks of goods that Spanish merchants had never even tried to sell. They had no political purpose, but their coming revealed the fact that the outside world was nearer to New Mexico by way of the Missouri border than by the mule and wagon track that stretched nearly 2,000 miles southward to Vera Cruz. Many adventurers, too, drifted into California.

Ships Bring Immigrants

The China trade and the northern whale fisheries, from which many New England fortunes were made, aided also in this peaceful penetration. Navigators on the Pacific learned that "great circle" sailing from Cape Horn to China took their ships close to the California coast. They always needed fresh water, and sought to fill their barrels at California ports. Their men, often sick from diseases that come from lack of fresh vegetables, found new health in the potatoes and fruits grown by California ranchers. In vain, Spain and Mexico forbade the trade. Vessels continued to anchor at the ports of San Diego and Monterey. Often sick sailors were left ashore; and able-bodied seamen deserted their ships.

Casual foreigners were soon to be found in every pueblo. They married daughters of Mexican ranchers, officers, and officials, and began to introduce "Yankee" notions of enterprise among the leisure-loving natives. Now and then fur traders climbed the Sierras and came down into the paradise of California. Jedediah Smith visited it more than once. John Sutter became a Mexican citizen without losing his desire for contacts with the outside world. When John C. Fremont explored the country (1843–44) looking for a great river to the Pacific, he found both hospitable residents who spoke his language, and bewildered Mexican officials who did not know how to make him leave.

Before the Mexican War opened in 1846, Texas was already in the United States, New Mexico was filled with American ideas, and California was coming under American influence. The Spanish system that had raised up the Southwest as a buffer to outside influences had broken down, and the Southwest would soon have been absorbed as a part of the Union without hostilities. (*See* Mexican War.)

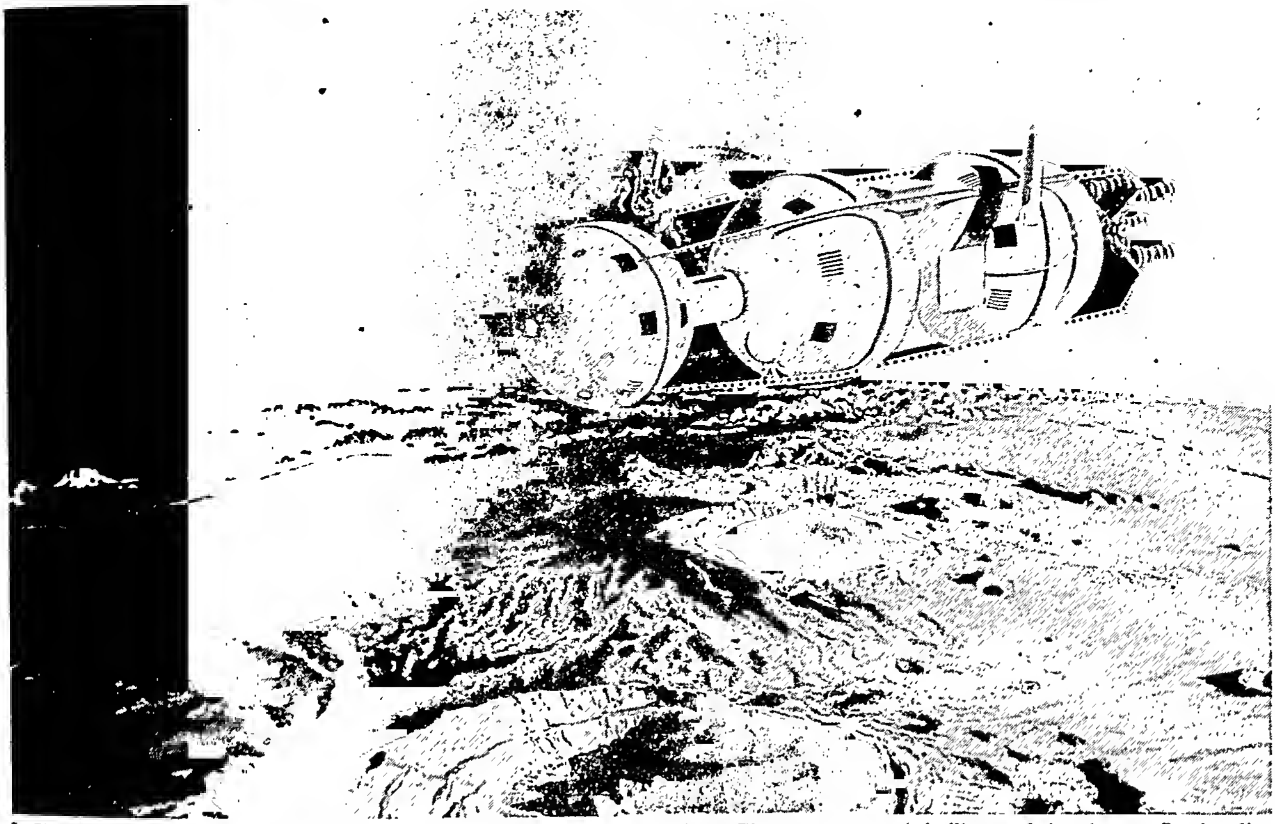
Yet in a sense, the Southwest conquered its invaders, for Spanish influences—names, architecture, and the manner of life in a gentle climate—made this wonderful region unlike any other in the United States. (*See also* Cattle; Far West; Indians.)

SOYBEAN. The soybean (or soya) is said today to have more uses than any other known plant. Yet, until recent years, United States farmers grew it only occasionally as a rotation crop which put nitrates back into the soil and was useful at the same time for forage. The discovery of the many other possible uses of the soybean was the work of chemists and food specialists, though much of what they found out scientifically had been learned long ago in the Orient, the native home of the plant.

Soybeans contain all the vitamins, especially "B," and twice as much protein and fat as beef. They are almost free of starch and sugar, and so can be fed to diabetics. They produce a milk more digestible than cow's milk. Other food products made from soybeans are coffee substitutes, cheese, macaroni, pancake flour, sausage filler, lard and butter substitutes, salad and cooking oil, and soy sauce or *shoyu*. The pulp or cake, called soybean meal, is a good fertilizer.

In industry, soybean oil has become a rival of cottonseed oil and linseed oil. It is used in paints, varnishes, enamels, soap, linoleum, and printing ink. The protein from the soybean resembles casein from cow's milk, and is used in paints, paper sizing, glue, and waterproofing for textiles. This protein, combined with formaldehyde, yields plastics for making automobile parts, notably gearshift knobs, window strips, and push buttons. Henry Ford was a pioneer in developing the industrial uses of soybeans.

The soybean plant belongs to the legume, or pod-bearing family. Its scientific name is *Glycine soja* (*Soja max*). It is two to four feet tall, with branching stems and three-parted leaves. The small lilac-colored flowers mature into pods containing from two to five beans. Stems, leaves, and pods are covered with stiff reddish hairs. Manchuria is the chief source of soybeans in the Orient (*see* Manchuria). The beans provide the protein lacking in the meatless diet of the poorer people of Japan and China. The United States, where the plants were introduced in 1804, now leads the world in production. About 200,000,000 bushels are raised here annually. They are grown for commercial use in over half the states. Illinois, Iowa, and Indiana lead in production.



In Chesley Bonestell's painting from 'Across the Space Frontier', a nonstreamlined spaceship hovers 50 miles above the moon's surface. The craters are Aristillus and Autolycus. In the distance are the lunar Appennine Mountains. (© Crowell-Collier.)

OUTER SPACE—*The* NEW FRONTIER

SPACE TRAVEL. The name space travel, sometimes called *astronautics*, has been given to a new science which studies conditions in the highest layers of our atmosphere and in nearby space. Its ultimate purpose is to send piloted rockets into these regions for further exploration. Properly speaking, space travel is not one but a complex of sciences: *physics* (for atmosphere information), *astronomy* (for information about the motions of bodies in space, whether natural or artificial, and for knowledge of the meteorite hazard), *engineering* (for the design and construction of piloted rockets), *chemistry* (for materials and fuels), *electronics and physics* (for communication), and even *medicine and psychology* (for the physical and mental well-being of the crew). Although this science is still largely in the study and planning stage, the first steps toward the realization of space travel have already been taken.

Early Ideas and Concepts

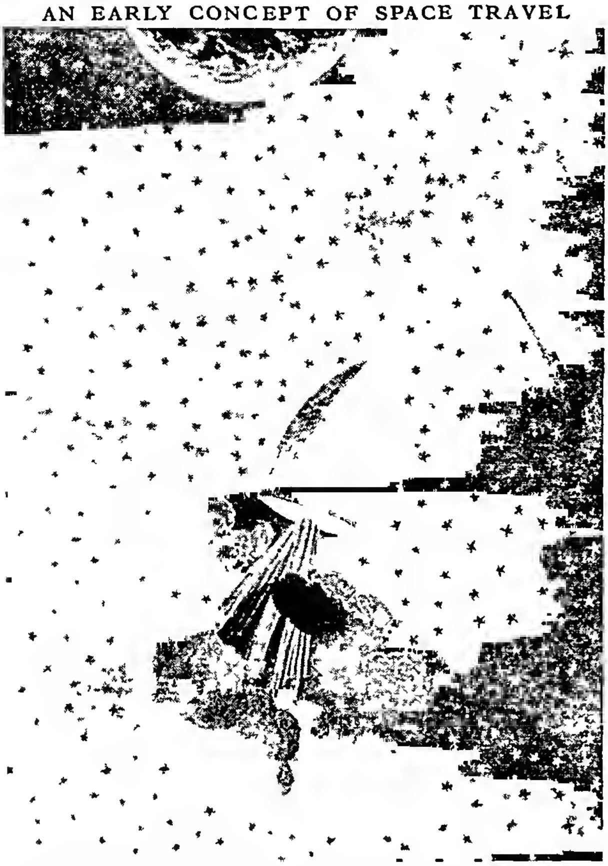
While the *science* of space travel is of recent origin, the *idea* of space travel has a long history. It started when scholars began to agree that the moon was not just a lantern in the sky but a solid body, comparable to the earth but smaller. The first author to write imaginative (and also satirical) stories about trips to the moon was Lucian of Samosata, who lived in the 2d century A.D. In one of his stories, 'True History', a ship is blown to the moon by a big storm. In another, 'Icaromenippus', the hero takes one wing from a vulture and one from an eagle and practices flying until he reaches the moon. Then the gods take away his wings.

It was almost 1,400 years before more stories about trips to the moon were written. One was by the German astronomer Johann Kepler and was written in Latin. Another, the first such story in English, appeared in 1638 under the title 'The Man in the Moone' and was written by Bishop Francis Godwin. The hero of this story flew in a device pulled by birds. He wanted only to escape from the island of St. Helena on which he was shipwrecked, but it happened that the birds he had trained migrated to the moon every year in the same manner in which other birds migrate to southern lands. Another moon travel story was written by Cyrano de Bergerac in 1648 and involved the use of huge powder rockets. Edgar Allan Poe wrote 'The Unparalleled Adventure of One Hans Pfaall' in 1835. His hero used a large balloon.

In 1865 a story appeared which for decades was the best known of them all—Jules Verne's 'From the Earth to the Moon'. It told of building a giant cannon that would shoot a shell to the moon. The shell would leave the muzzle of the gun with a velocity higher than seven miles per second. We will see later why Verne used this figure. In 1880 Percy Greg, an Englishman, published his novel 'Across the Zodiac', which is about a trip to Mars by means of "negative gravity," called *apergy* in the story.

It is easy to see how the progress of science influenced the writers. Up to about the time the balloon

AN EARLY CONCEPT OF SPACE TRAVEL



When Jules Verne wrote 'From the Earth to the Moon' in 1865, he believed that spaceships of the future would have to be streamlined. His illustrator drew this simple rocket. This article explains why streamlining is not necessary to space travel.

was invented most writers thought that a flight to the moon was the same as a flight from one mountaintop to another, only longer. About a century ago they began to realize that there was a fundamental difference involved and that balloons or wings could not carry men even to the top of the atmosphere; hence Verne's cannon shot and Greg's "negative gravity."

Beginnings of Space Travel Science

The first man who seems to have considered space travel as a challenge to the engineer rather than as a theme for a novelist was the German inventor Hermann Ganswindt, who began drawing plans in 1890. His ship was to be propelled by what would now be called a "rocket motor," using "dynamite or another suitable high explosive" as a fuel. Of course, it would not have worked but Ganswindt was on the right track. About ten years later a Russian schoolteacher, Konstantin E. Ziolkovsky, began to think along similar lines and evolved the idea of large piloted rockets without, however, being able to give detailed design sketches. Both Ganswindt and Ziolkovsky are now considered "forerunners." They had the right idea but lacked the knowledge to make a true contribution.

The first real achievement was made by Dr. Robert H. Goddard of Clark University in Worcester, Mass. In 1919 he published 'A Method of Reaching Extreme Altitudes', which gave formulas for calculating the power necessary for a desired performance of a rocket and suggested the possibility of an unmanned rocket shooting to the moon. The rocket was to crash on the moon's surface and signal its arrival by exploding a load of flash powder. Four years later a German mathematician, Prof. Hermann Oberth, published 'A Rocket into Interplanetary Space'. In this book, which is even more mathematical and still harder to read than Goddard's highly technical treatise, Oberth developed methods for calculating the size of rockets capable of leaving the earth's atmosphere. He made suggestions about the construction of such rockets and put special emphasis on the fact that such large rockets should use liquid fuels.

Whether liquid fuel rockets could actually be built remained in doubt, however. It could not be proved on paper and had to be tested. For this purpose a group in Germany founded a Society for Space Travel (1927) and began building and testing liquid fuel rocket motors and, eventually, small liquid fuel rockets. It became known later that Dr. Goddard, working secretly, had done the same thing several years earlier than the German society. The society published a monthly journal called *The Rocket*, where many theoretical questions were discussed and many new ideas submitted for the first time. After Hitler rose to power the society was dissolved. Rocket research in Germany did not stop, however. Some time earlier the German army had hired one of the society's engineers, Wernher von Braun, who later became technical director of the Peenemunde Research Institute where the rocket V-2 was developed (*see* Guided Missiles). The modern science of space travel, then, originated mostly during the decade from 1920 to 1930 when the theoretical foundation was laid.

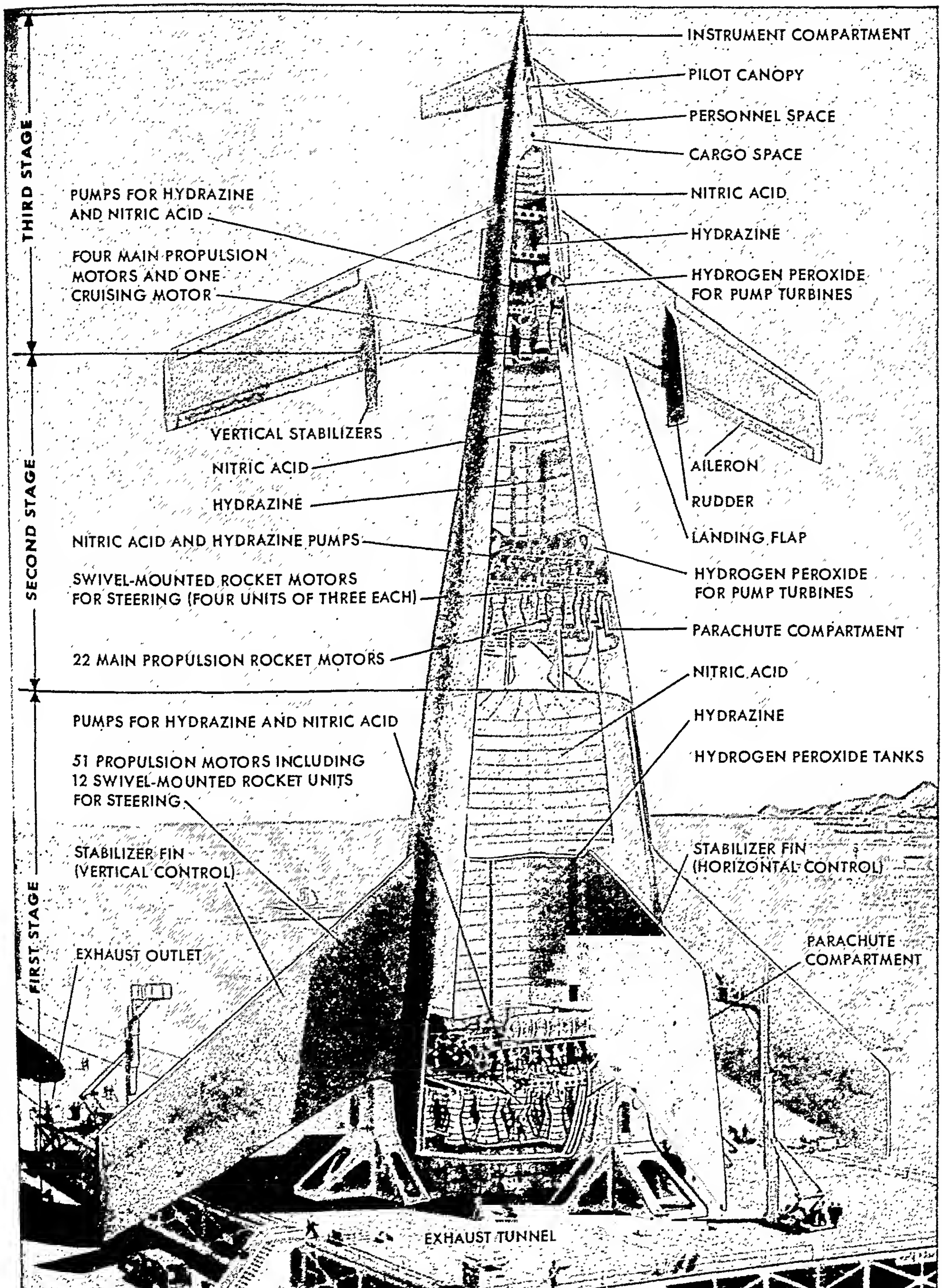
Modern Concepts

Nobody expects the spaceship of the future to be anything but a large liquid fuel rocket. Ideas about "antigravity" devices of some kind, which can be found in science fiction, never were admitted into the realm of scientific speculation and planning. We simply do not know what gravity really is and therefore cannot even guess whether it could be eliminated even theoretically. Nor is there any place for atomic energy in present plans for very much the same reason. We still know very little about atomic energy except that we can make it produce heat. This can be utilized for such purposes as the power plant of a submarine or a surface ship, where the atomic pile takes the place of the firebox in a steam turbine power plant. This principle, however, cannot be applied to a rocket. (*See* Atoms; Gravitation; Matter; Energy.)

Of course, if tomorrow or next week or next year, somebody discovers the "nature of gravity" or finds a new and useful way of releasing atomic energy, the whole picture will be changed. But space travel theory is not based upon things that might be discovered—it rests on what we know *now*.

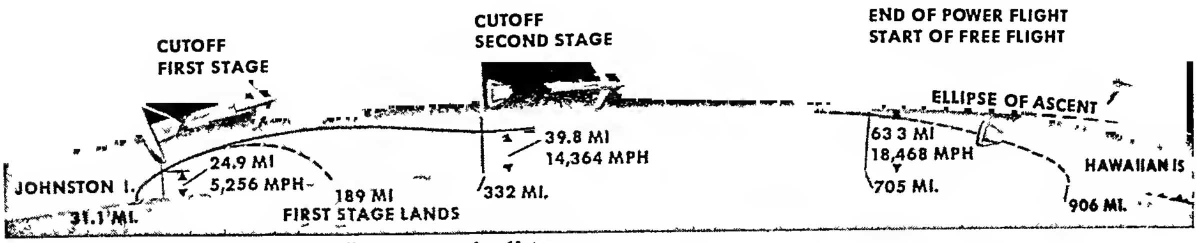
To understand the principle let us consider a simple example—a shot to the moon. The basis of the theoretical reasoning involved is a simple natural

THE THREE-STAGE ROCKET SHIP

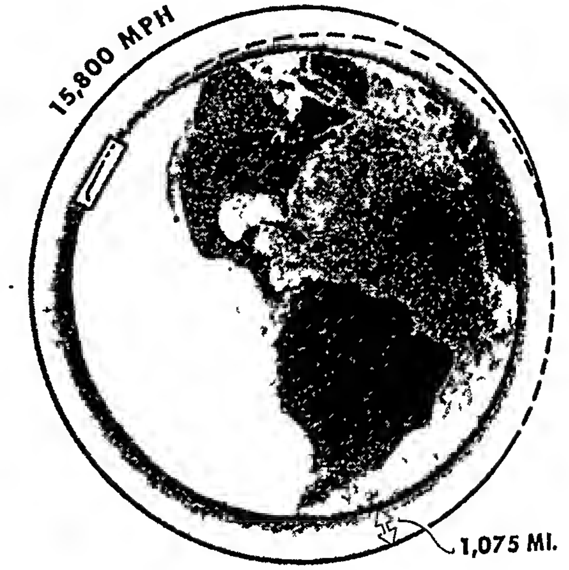


This picture of a three-stage rocket by Rolf Klep shows the ship being prepared for the take-off. It is 265 feet tall, about as high as a 24-story office building. The huge rocket has an over-all weight of 7,000 tons (about the same as a light cruiser). The stationary structure used for fueling, loading, and boarding is not shown in the picture. (© Crowell-Collier.)

HOW THE ROCKET GETS TO THE SPACE STATION



The above diagram shows the take-off maneuver, the distances, and velocities involved in the rocket's flight to the space station. To the right is the earth, with the station's orbit drawn to scale. The broken line indicates the rocket's elliptical ascent to the station's orbit. (© Crowell-Collier.)



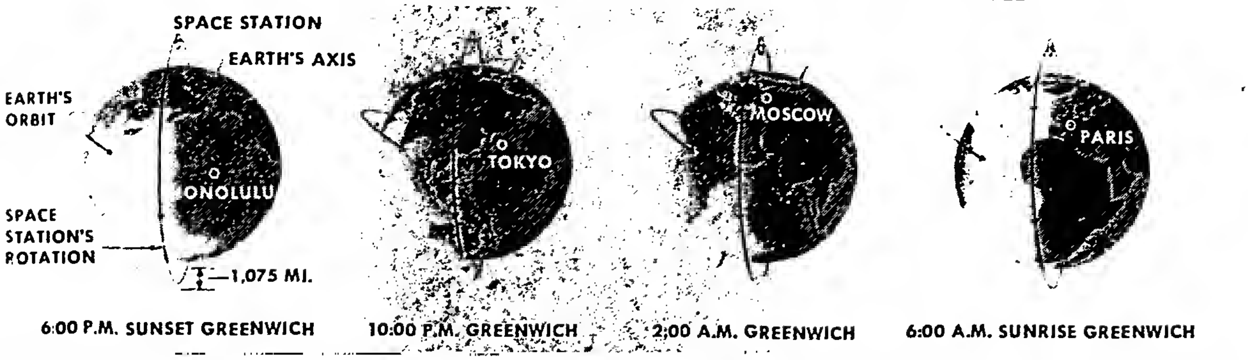
law. If you drop a heavy weight from a height of 100 feet it will strike the ground with a certain impact velocity. If you wanted to throw the weight to a height of 100 feet you would have to throw it at the same speed as the impact velocity from 100 feet. The same applies to a 200-foot fall. Of course, the impact velocity resulting from a 200-foot fall is higher than that resulting from a 100-foot fall; but it is not twice as high. With greater and greater heights the impact velocity increases steadily, but the heights increase at a faster rate. Therefore a weight, even if it fell from an "infinite height," would not strike the ground with infinite velocity. The impact velocity resulting from a fall from an infinite height is 7 miles per second—more precisely, 6.965 miles per second, which is equal to 25,075 miles per hour. This is the highest velocity the earth's gravity can produce. Logically, then, if an object were shot upward with this velocity the earth's gravity could not hold it and it would escape forever.

For this reason a velocity of 7 miles per second is called the "escape velocity," although mathematicians prefer to call it the "parabolic velocity." They point out that velocities higher than 7 miles per second, known as "hyperbolic velocities," would also effect an escape. Though this is correct, the term escape velocity is now in common usage. Naturally a rocket needs some time—anywhere from 4 to 12 minutes, depending on its acceleration—to build up to such a velocity and it may have climbed as high as 300 miles during this time. Theoretically such a rocket would not have to attain the parabolic velocity mentioned since this figure is the one which is valid for the earth's surface. Our rocket, in theory, would only have to attain the parabolic velocity which applies to a height of 300 miles. This is somewhat less than the figure which applies to the surface, but the difference is comparatively small, smaller at any rate than the safety factor which the engineer would like to incorporate in his rocket.

If such a rocket were aimed, *not* at the moon but at the spot in the sky where the moon would be four days later, it would crash on the lunar surface, even if the aim were not perfect. The surface to surface distance between earth and moon is about 235,000 miles. When the rocket has traveled 90 per cent of this distance the moon's gravity is stronger than that of the earth and will pull the rocket down.

If we tried to build such an unmanned moon rocket (called the Moon Messenger to avoid confusion with a manned moonship) we would soon find out that no rocket can hold enough fuel to attain escape velocity. The main reason is that the rocket after having burned half its total fuel supply, for example, still has to carry the fuel tanks and a battery of rocket motors which by then are unnecessarily large and heavy. One might design the rocket in such a way that empty fuel tanks and unnecessary rocket motors are dropped; but it is easier to build a rocket which is an assembly of several "stages." The rocket which takes off from the ground really consists of several rockets. The largest of them forms the bottom section and is ignited first. As soon as the first stage has spent its fuel, the second stage takes over, leaving the burned out first stage behind. When the second stage has spent its fuel, the third stage takes over; the principle being that not even a fraction of an ounce of weight is carried for even a fraction of a second longer than necessary. A Moon Messenger would have to be a four-stage rocket.

A MAN-MADE SATELLITE CIRCLES THE EARTH



The space station circles the earth once every two hours. From its position in relation to the continents it is evident that the station's people would be able to see every point on the earth at least once in every 24-hour period. (© Crowell-Collier.)

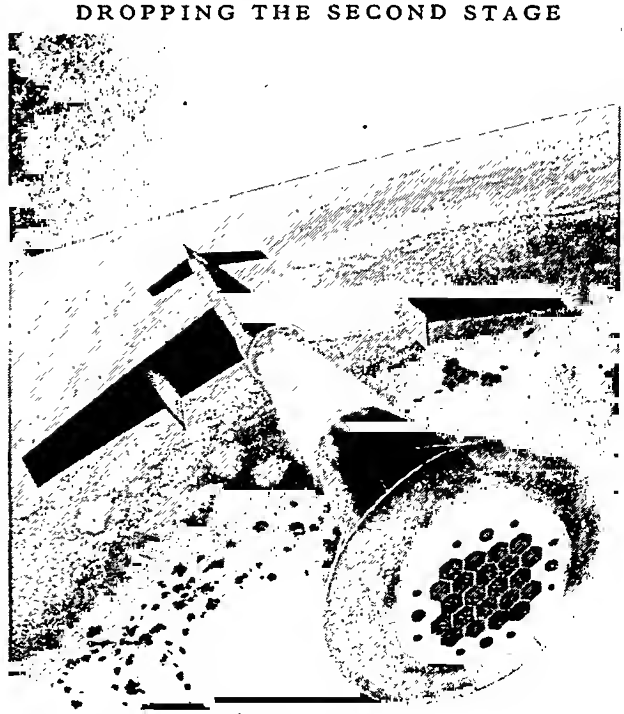
The Moon Messenger, however, will not be the first step in the conquest of space. The first step will be to put a comparatively small rocket into space *and leave it there.* To do this the rocket, after the usual vertical take-off which is to carry it through the densest layer of the atmosphere along the shortest possible route, would tilt its nose toward the east and climb through the remaining layers of the atmosphere at a slant. If nothing else were done the rocket, after reaching a high point (called *apogee*) somewhere in space, would slant down again and re-enter the atmosphere. To keep it in space an additional burst of rocket power is needed just before or upon reaching the apogee. Then the rocket would stay in space permanently, circling the earth like a tiny moon. Instruments in the head of the rocket would report their findings to ground stations by means of a built-in automatic transmitter, just as is being done now with high-altitude research rockets (*see also* Rockets). Such a rocket would have to have only three stages. The third stage would remain in space.

After this experiment has been carried off successfully it would be repeated, with some modifications, with a manned rocket. Von Braun has designed a three-stage rocket ship which could perform this maneuver. The manned rocket, of course, would not stay in the orbit permanently. After circling the earth repeatedly the pilot would turn his ship around (by means of a flywheel arrangement in the ship) so that the nozzles of the rocket motors point in the direction of movement. A short duration burst from the rocket motors would cause the ship to lose speed so that it would dip into the atmosphere again and finally land like an airplane. For this reason the third stage of the manned rocket ship is equipped with wings which do not help at all during the take-off—their function is to enable the rocket to land. The landing speed of Von Braun's third stage is surprisingly low because the rocket is large and bulky but very light after having burned virtually all its fuel. The landing speed will be 65 miles per hour—roughly half that of a modern air liner.

It is possible that such an experiment may be made first with a three-stage rocket of smaller dimensions than Von Braun's design, which has a take-off weight of 7,000 tons, including a pay load capacity of 36.5 tons. This pay load is not needed for the first tentative flight into space but is required for the next step: the building of a manned space station. About a dozen flights of such ships would be required to carry all the material for a large space station into an orbit around the earth. When finished, this station would have the shape of a giant wheel some 250 feet in diameter.

The purpose of such a space station would be fourfold. Its main job might be called the "earth watch." By means of telescopic photographs, which are then projected on a screen, the men in the space station would be able to distinguish rather small objects. It would be easy for them to spot concentrations of ships or airplanes or troops. Aside from the military use the earth watch would have important peaceful applications. We do not know right now, for example, how much of the earth is covered by clouds at any

DROPPING THE SECOND STAGE



The rocket's third stage (cabin-equipped) is on its way to the space station. It is now using its own motors. The second stage, its fuel exhausted, has just been dropped. (© Crowell-Collier.)

given moment and, since weather stations are concentrated in North America and in northern Europe only (an area which is just about 2 per cent of the earth's surface), weather predictions are necessarily sketchy and often are wrong. The existence of a space station would guarantee knowledge of weather conditions anywhere on the globe. This might permit reliable prediction of the weather for any spot, often many weeks in advance. Since the space station would be a very good relay station for short-wave and television broadcasts, it is not unlikely that special stations might be put into space for this purpose only. They would not even need to be manned, except for occasional maintenance visits.

The second job of the space station might be termed the "sky watch" and would be mostly astronomical. Because the instruments would not be hampered by atmospheric conditions many of the puzzles of modern astronomy (for example, the period of rotation of Venus, the nature of the "canals" of Mars, and the number of lesser moons of Jupiter, to name a few), would be solved in a short time. It is possible that the sky watch would enable astronomers to predict the occurrence of the magnetic storms which originate in the sun and disrupt communications on earth.

The third function of the space station would be to serve as a research laboratory. Conditions in and near the station differ from those on the ground. At the bottom of the air ocean it is hard work to produce a vacuum even in a relatively small container (*see* Vacuum). Around the station an unlimited vacuum would be available for experimentation. By mere concentration of the sun's rays a substance to be tested could be heated to almost any temperature. By keeping it in the shadow of the station for a few weeks the same substance could be cooled almost to absolute zero. It would be possible also to take advantage of the apparent absence of gravity. Nobody knows, for example, how the growth of crystals would be affected under such conditions.

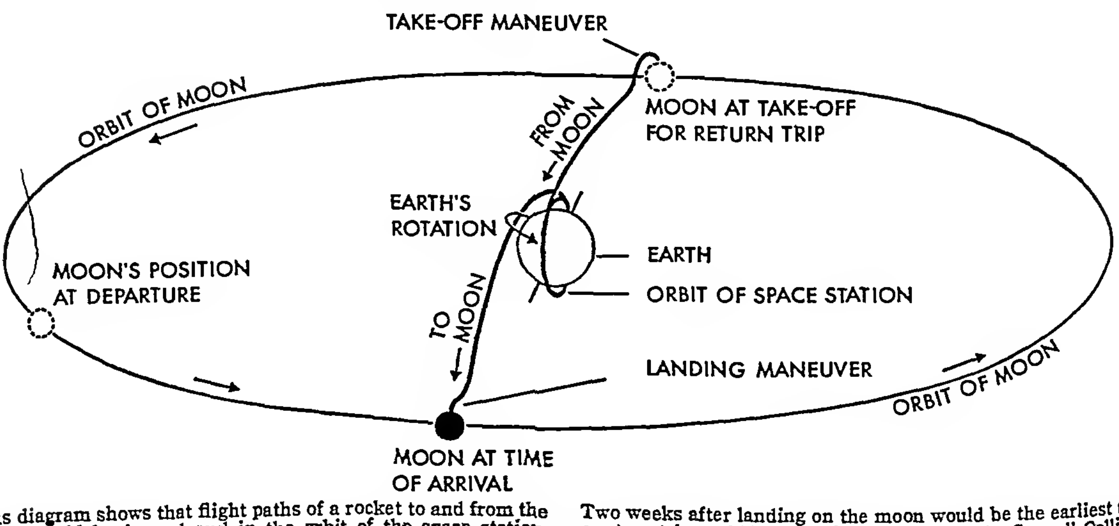
The fourth job of the space station would be to serve as a starting point for long-range exploratory trips. The moon would probably be the first goal, and then the planets of the solar system closest to the earth—Venus and Mars.

Before this can be explained it is necessary to discuss the orbit of the station itself. Theoretically a station can be located anywhere, provided it is so far out of the atmosphere that there is no air resistance left. To be safe therefore, the station's orbit should not be lower than 300 miles above sea level. It is generally true that a more distant orbit would require more fuel for the ships which have to leave the ground to supply the station. On the other hand, a more distant station can observe a larger area of the earth at any one moment. If the station were too far away, however, it would be difficult to distinguish fine detail. The compromise height suggested by Von Braun is 1,075 miles. At that distance the station would have to move at the rate of 4.4 miles a second to stay in the orbit and would need precisely two hours for one revolution around the earth.

Theoretically the orbit of the space station could have any position relative to the earth. It could circle over the equator or move around the earth from pole to pole. Each would have advantages and disadvantages. The best compromise would be an orbit standing vertically on the plane of the ecliptic —the orbit of the earth around the sun. With such an orbit every point on the ground would be visible to the space station at least once in a 24-hour period.

For exploratory trips the space station offers several advantages. To begin with a long-range spaceship, brought up piecemeal by the three-stage ships and assembled in the orbit of the station, would begin its journey from a point outside the atmosphere. Streamlining would not be necessary, as a rule, and it would therefore be possible to design the ship in such a way that empty fuel tanks could be thrown off (for a streamlined ship this is almost

A SPACESHIP'S FLIGHT PATHS



This diagram shows that flight paths of a rocket to and from the moon would begin and end in the orbit of the space station. Two weeks after landing on the moon would be the earliest that a return trip could be made in this manner. (© Crowell-Collier.)

impossible without ruining the streamlining). A more important advantage is that the ship, traveling around the earth with the station, already has a speed of 4.4. miles per second. To break away from the earth the ship has only to attain the difference between the 7 miles per second it would need if it tried to take off from the ground and the 4.4 miles per second it already has. This simple subtraction demonstrates what has been labeled since 1928 as the "astronautical paradox"; namely, that a trip to the moon from a space station would be easier to accomplish than the trip to the space station from the earth. The first step—the establishment of the station—would be the most difficult.

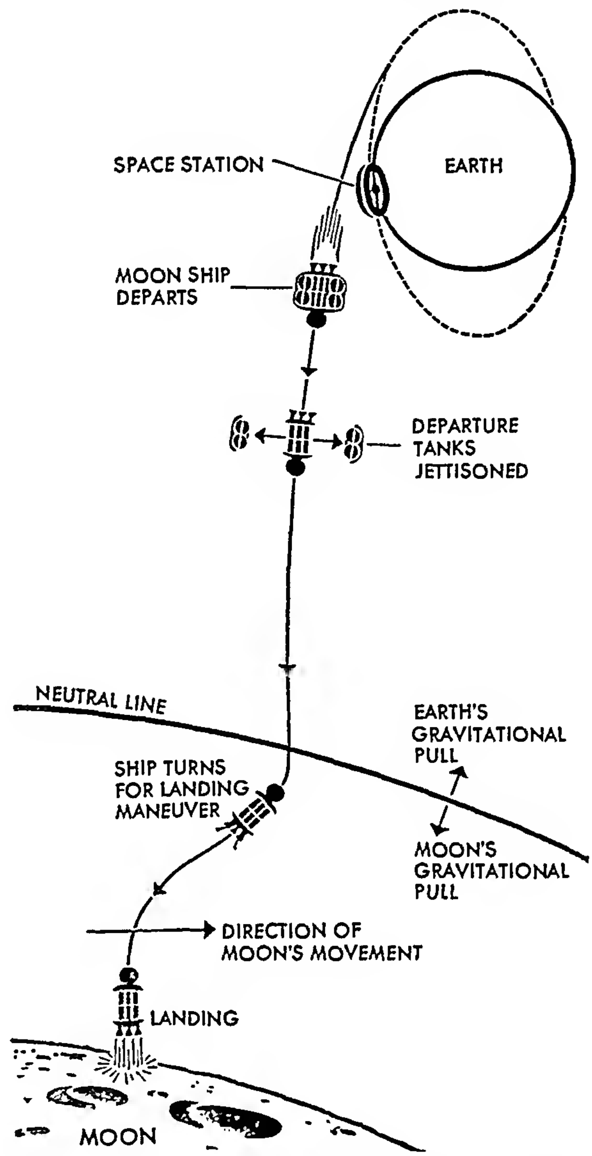
It is certain even now that the first exploratory trip from the space station will go to the moon; but it will not include a landing on the moon's surface. The moonship will simply travel along a very long and narrow ellipse which begins and ends at the orbit of the space station and has its farthest point somewhat beyond the orbit of the moon. The timing would be such that the moon would pass *between* the ship and the earth when the ship is at the farthest point of its voyaging ellipse. The crew would then be able to photograph the unknown far side of the moon which can never be seen from either earth or the space station.

The first landing on the moon could take place soon after the return of the "round-the-moon" ship. The landing, however, would not take place on the moon's far side. It would have to be made on the side facing the earth and visible from the space station because the station, the expedition, and the base on earth would want to be in steady short-wave contact with each other. This would be impossible if the expedition landed on the moon's far side because short radio waves, like light, travel in straight lines (*see* Radio).

In the case of the trip to the moon, with or without landing, no attention need be paid to the fact that the earth moves around the sun. The moon does too, so that seen from the sun, both the earth and the moon are always in the same direction and move with almost the same speed.

However, when space travel has progressed to the point where an expedition to Mars or to Venus can be contemplated, the fact that the earth moves around the sun becomes very important. The other planets also move in the same direction around the sun (*see* Planets). However, their velocities differ. The closer a planet is to the sun, the faster it has to move to stay in its orbit. If a spaceship moved near the earth and in the same direction, but with a higher velocity, it would be more powerful than the sun's attraction at the distance of the earth from the sun—about 93 million miles. Therefore the ship would drift outward into space, slowly approaching the orbit of Mars. With correct timing it would reach Mars's orbit to coincide with the arrival of the planet. With the least possible fuel expenditure this trip would take about 258 days.

A TRIP TO THE MOON



In this sequence of events a spaceship travels from the space station (top) to the moon. Note that the ship's rockets are turned *toward* the moon for landing. (© Crowell-Collier.)

An immediate return trip would be impossible because the ship, if it continued on its travel ellipse which touches the orbits of both the earth and Mars, would reach the orbit of the earth again, but the planet would be elsewhere. It would be necessary to stay on or near Mars until the two planets again reached the proper positions. This waiting period would amount to 455 days, so that a complete round trip to Mars would require approximately 258 plus 455 plus 258 days, or 2 years and about 8 months. All this applies to trips with the least possible fuel expenditure. By the time an expedition to Mars becomes possible, fuel economy may not be necessary, so that travel time can be shortened.

Can Man Endure Space Travel?

If we accept the engineers' predictions and assume that they can actually build what they now have on drawing boards, there is still doubt as to whether peo-

ple could endure the strain of a voyage into space. There is no complete answer to this question, yet a surprisingly large amount of information is available. A trip to a space station at least is known to be possible. In the take-off of a ship for the space station we have two conditions occurring in succession. During the take-off the crew would be under considerable acceleration which, twice in the course of one flight, would rise to about $9g$ ($9\times$the normal pull of gravity). This means that for a few seconds they would feel as if they weighed nine times as much as they actually do (*see* Gravitation). On the average the acceleration would be about $3.5g$, and the total duration of the period of high acceleration about 300 seconds.

Fortunately the effects of high acceleration can be imitated by a centrifuge, and centrifuge tests have shown that men can stand even higher accelerations and for longer periods than would be required during a voyage to a station, without "blacking out." Immediately after the rocket motors shut off, the men would be under "zero-g condition," which means that they would feel as if they had no weight at all. This condition is much harder to simulate; but it can be approximated for a short time by pulling a plane out of a power dive and switching the engine off simultaneously. In this test some pilots feel very uncomfortable while others do not; so it is probably justifiable to say that some people will not be disturbed by a zero-g condition. In a flight to the space station the zero-g condition would last only 51 minutes.

The station itself would be under zero-g at all times; but there something could be done about it. By rotating the wheel-shaped structure around its center, centrifugal force is produced in the rim, substituting for (and actually imitating) gravity. This provision would be followed even if it should turn out that continued zero-g has no harmful effects, because the presence of even pseudogravity would make the everyday tasks much easier. Furthermore it would not be necessary to redesign instruments for operation under zero-g.

There are two hazards to life in a space station. One is the so-called cosmic rays—actually very fast, and therefore very penetrating, nuclear particles. There is no doubt that enough of them would prove fatal, but their danger has been exaggerated beyond all reason. It is true that nothing can be done about cosmic rays, but the best authorities believe that exposure for a short period would be completely harmless. Meteorites are the second hazard. It sounds very formidable if one reads that a space station might be struck by a meteorite at least once every hour. The average size of these bodies, however is less than the size of a grain of clay. These tiny particles would be stopped by a "meteor bumper"—an outer cover of sheet metal held on studs some two inches from the skin proper of the space station. Meteorites large enough to break through the meteor bumper are so rare that a penetrating hit is not likely to occur more frequently than once in a century.

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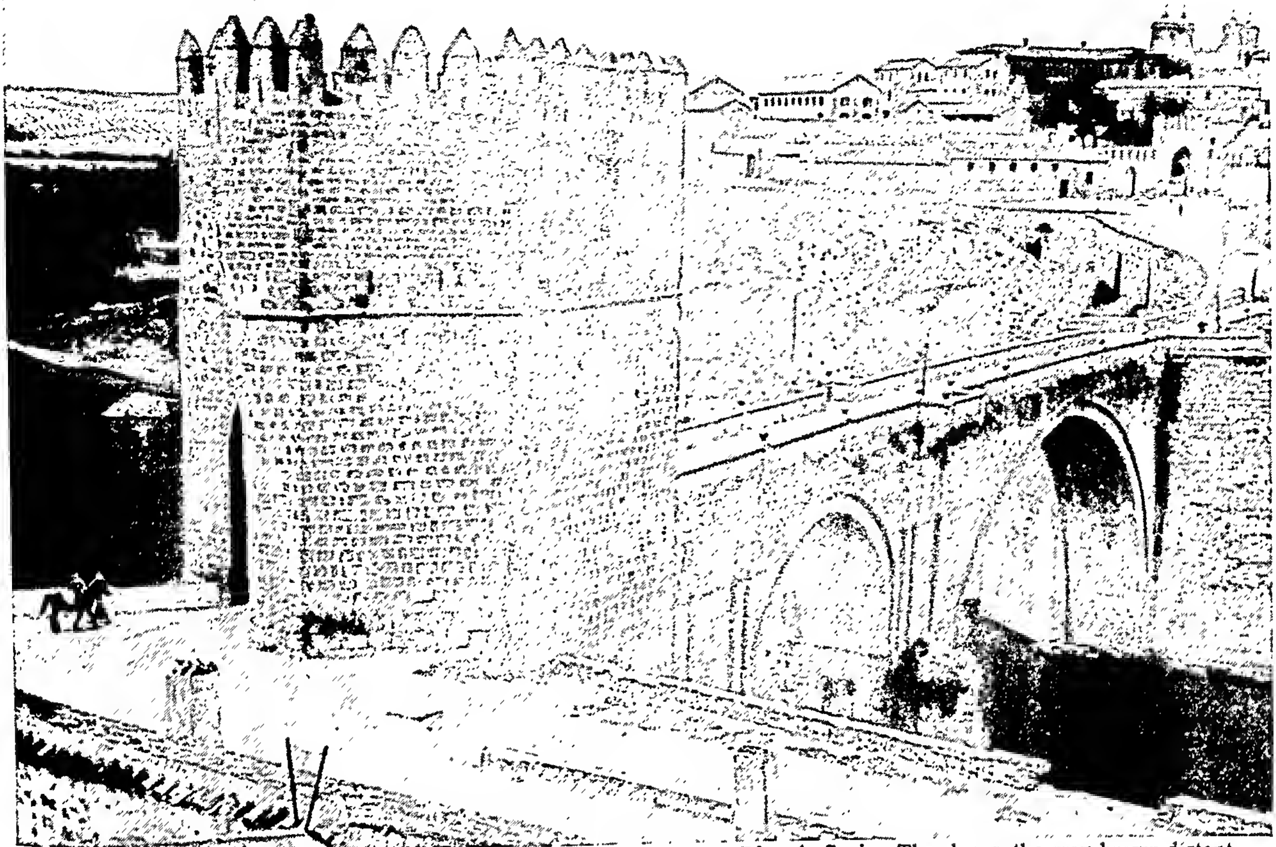
SPAIN—*Once the Greatest Power in Europe*



Here a 13th-century tower guards the walled city of Toledo on the Tagus River in Spain. The slopes, the gray-brown distant hills, and the great white clouds in the sharp sunshine are typical of the vast central plateau of Spain.

SPAIN. Proud Spain once ruled nearly half the world. In the 16th century most of Europe paid tribute to Spain. Towering Spanish galleons brought treasures of gold and silver from its rich colonies in the Americas. The daring Spaniards, however, could not hold their vast realm. They had extended themselves too far and they lost their possessions one by one.

Today Spain is a backward country, but the Spaniards are working to solve their problems and to improve living conditions. The gap between the few very rich and the many very poor is enormous. There are several reasons for Spain's difficulties. Three chief causes are the great mixture of peoples in Spain; the exhausting effects of a savage civil war in 1936–39; and, finally, the strange natural features of the land itself.

Extent.—East to west, greatest distance, about 650 miles; north to south, about 550 miles. Area, 190,050 square miles; with Balearic Islands, Canary Islands, etc., 194,800 square miles. Population (1950 census), 27,976,755. Colonies (in Africa), over 128,000 square miles; population, more than 1,000,000.

Natural Features.—Pyrenees, separating Spain from France; Cantabrian Mountains, Sierra de Guadarrama, Sierra de Gredos, Sierra de Gata, Montes de Toledo, Sierra Morena, dividing and bounding the central plateau; Sierra Nevada to the south (highest point, Mulhacen, about 11,420 feet). Chief rivers, Ter, Llobregat, Ebro, Guadalaviar, Jucar, and Segura, flowing into the Mediterranean; and the Minho, Douro, Tagus, Guadiana, and Guadalquivir, flowing into the Atlantic Ocean.

Products.—Wheat, barley, other cereals, cotton, sugar beets, sugar cane, vegetables, grapes and wine, olives and olive oil, oranges and other fruits, nuts; silk; sheep and goats, wool, other livestock; sardines, tunny fish, codfish; coal, lead, iron, copper, mercury, zinc, sulfur; cotton and woolen goods, paper, cork, glass, sugar, tobacco products, leather goods.

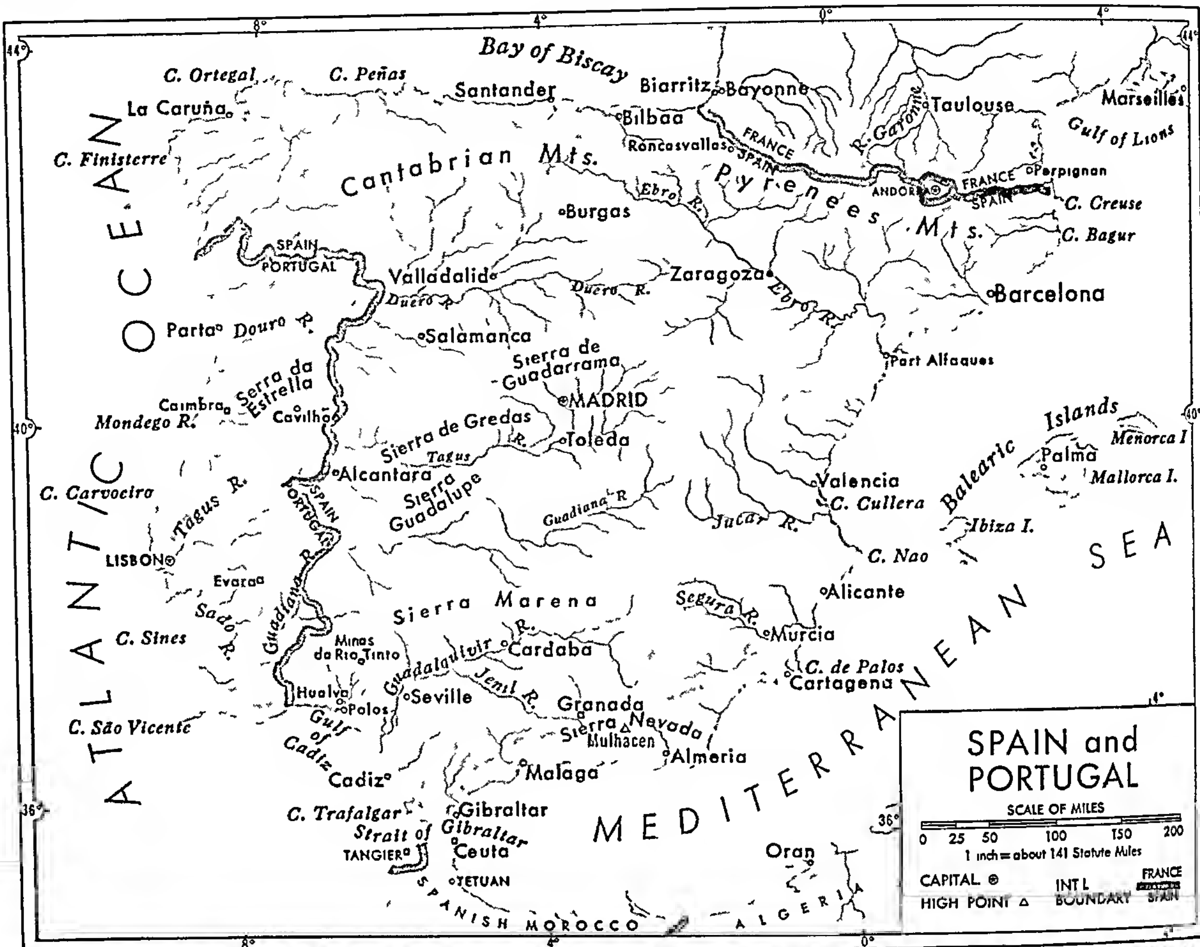
Cities (1950 census).—Madrid (capital, 1,618,435), Barcelona (1,280,179). Populations of cities include suburbs: Valencia (509,075), Seville (376,627); Malaga, Zaragoza, Bilbao (over 200,000); Córdoba, Granada, Vigo, Valladolid (over 120,000).

Natural Features

Spain occupies most of the Iberian peninsula in the southwest corner of Europe. The remaining fragment is occupied by Portugal. The Iberian peninsula is one of the three great peninsulas that jut into the Mediterranean Sea. With an area of 190,050 square miles, Spain is about the size of Pennsylvania, Ohio, Indiana, and Illinois combined. The number of people who live in Spain is also about the same as their combined population.

The land of the Spanish people is an isolated country. In the north the massive, snow-crested Pyrenees rise in a jagged wall from the Bay of Biscay to the Mediterranean, cutting Spain off from France and the rest of Europe. Spain's southern tip is only about 12 miles from Africa and was once part of it. A French proverb says that Europe ends at the Pyrenees and there Africa begins. Like Africa, Spain has a long coast line but too regular for many good harbors.

Spain itself is cut up by mountains and rivers



This map shows how Spain is isolated from the rest of Europe. At the north stands the great wall of the Pyrenees and to the west mountains bar the way to Portugal. Rivers and mountains cut Spain itself into many regions, each with its own customs

into many isolated regions. Some are so beautiful that visitors have called Spain the "land of romance" and dreamed of "building castles in Spain," where the sun is golden and the streets gay with whirling dancers and gypsy music.

Mountains, Meseta, Rivers, and Lakes

Only a very little of the country is really like that. Spain is one of the more mountainous countries of Europe. Most of its people are crowded into narrow strips of coastal lowland along the Bay of Biscay to the north and the Mediterranean Sea to the south and east. Rising abruptly from the ribbons of lowlands are great ranges of mountains that encircle the country like a ring. Thrusting up within this ring is a vast plateau, the Meseta, which occupies more than half the area of Spain. The Meseta, which averages about 2,200 feet in altitude, is itself ribbed with mountains and hills.

The chief mountains of Spain are the giant Pyrenees, with their craggy line of summits towering from 8,000 to 9,000 feet (*see* Pyrenees). Across the northeast rise the Cantabrian Mountains, where peaks reach more than 8,000 feet. Ranges ridging the Meseta are the Sierra de Guadarrama, the Sierra de Gredos, and Sierra Guadalupe. In Spanish *sierra* means "saw," and the name is frequently given to a mountain range because of its saw-toothed crest line. In the south the Sierra Nevada plunges from Mulhacen, at 11,420 feet, down to the coastal fringe of the Mediterranean. Between these various ranges loom abrupt hills, dusty brown highlands, and sharp valleys.

Several rivers flow through Spain, but there are only five principal streams. They are the Ebro, Duero, Tagus, Guadiana, and Guadalquivir rivers. Only the Ebro, in the north, and the Guadalquivir, in the south, are wholly inside Spain. The Duero, in the northwest, and the Tagus, in central Spain, flow through Portugal to empty into the Atlantic Ocean. The many-branched Guadiana sprawls over the southern part of the Meseta, then flows south to drain into the Gulf of Cadiz at the Spanish-Portuguese border.

Many Spanish rivers have *Guad* in their name. This comes from a Moorish word *wadi*, which means a stream that is dry for much of the year. In Spain that time of year is the summer.

Spanish rivers have little value for transportation. The mouths of the Tagus and Duero, which are in Portugal, provide good harbors; but of the wholly Spanish rivers only the Guadalquivir is navigable for any considerable distance from the sea. Ships sail the

Guadalquivir as far as Seville. The twisting gorge of the Ebro makes it useless for navigation. The valleys of other rivers also wind in deep, rocky clefts as they cut across the Meseta.

Spain has only two really large lakes, and they are actually lagoons of the Mediterranean in the east coast provinces of Valencia and Murcia. Small Alpine lakes dot the mountains, and little salt lakes break the brown monotony of the steppe regions of the Meseta.

Varied Climate

For the moderate size of the country, Spain has a surprising variety of climate. It differs in four general regions—northern Spain around the Bay of Biscay and the Atlantic coast; central Spain, or the Meseta; southernmost Spain; and the Mediterranean coast.

Northern Spain has a marine climate, with mild but damp winters and cool summers. The west slopes of the mountains, facing the Atlantic, receive the heaviest rainfall in Spain and are one of the wettest regions in Europe. In general they receive about 35 inches, and some places up to 60 inches annually. Most of the rain falls during the winter, but it is ample throughout the year for farming, grazing, and forestry.

The climate of the rest of Spain may be called generally Mediterranean—hot, dry summers and mild winters with light rainfall. There are, however, regional differences. The climate of the Meseta is harsh. Winter is bitter, with occasional heavy snowstorms. Summer is intensely hot in the daytime, with a sharp chill at night, and sudden blasting winds frequently blow the dust in choking clouds. The wall of mountains cuts the Meseta off from the moisture-bearing westerlies. The scanty rainfall waters the sun-baked plateau with only 12 to 14 inches a year—some years, even less, causing tragic droughts.

The southern tip of Spain is semidesert, with virtually no winter. The eastern coast has the typical Mediterranean climate, with brief, mild winters and long, rather hot summers. Rainfall there is only about 12 to 22 inches annually.

Plants and Animals

Plant life is a mixture of the types found in Europe and Africa. Spain was once well-forested, but ruthless land-clearing leveled nearly all the timber. Today only about 5 per cent of the country is in true forest, and about a third of this timber is drought-resisting pine. The arid regions also have the evergreen oak and the cork oak. Scrub evergreen bushes cling here and there to the parched Meseta. In the damp north the mountains are green with oak, chestnut, ash, beech, and birch. Poplar groves stand in the few swampy lowlands of the southeast coast. In the extreme southwest, near Gibraltar, are dwarf palms and plants like those in semidesert north Africa.

Animals too are a mixture of European and African. The European animals include deer, squirrels, hares, Spanish fox, Spanish wolf, and the Andalusian wildcat. Among the African types are the Barbary apes, genets, chameleons, Spanish Imperial eagles, and azure-winged magpies. Lizards and snakes abound.

NORTHERN MOUNTAINS AND SOUTHERN COAST

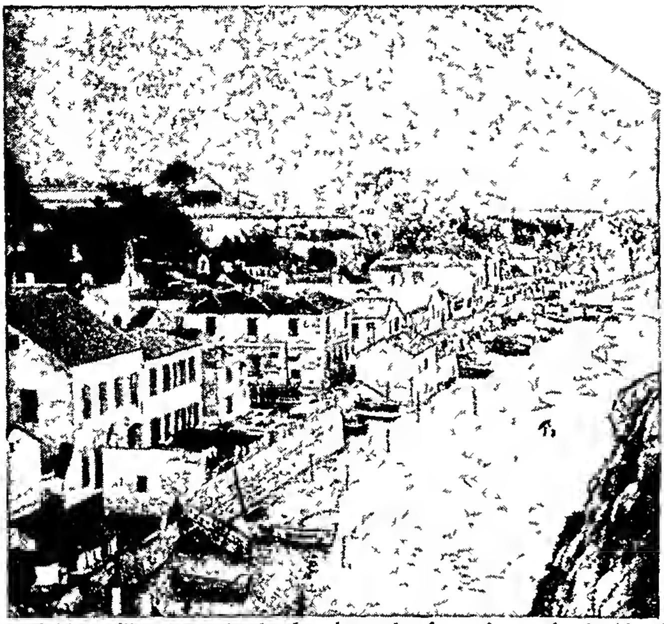
This wooded valley, with its cool mountain stream, is typical of the Pyrenees. Most of Spain's broad-leaved trees grow in this region.

Malaga, in southern Spain, grows grapes for wine on the terraced Mediterranean coast. Fruit and olive trees dot the rich vineyards.

The People and Their Differences

The Spanish people have one of the oldest and most mixed heritages in Europe. They are descended from

MAKING A LIVING FROM THE SEA AND ON THE MESETA



A fishing village crowds the beach at the foot of a rocky highland in Catalonia, in northeastern Spain. Spaniards eat fish often and so export little of their relatively small catch. At the right, one of Spain's many shepherds looks up from his lonely work on the Meseta, the almost treeless plateau of central Spain. His blanket is for the bitter night winds.

the ancient Iberians, who were invaded by the Carthaginians, Celts, Romans, Vandals, Visigoths, and Moors. Many Jews also entered Spain. All the proud, strong invaders helped to mold the Spaniards of today.

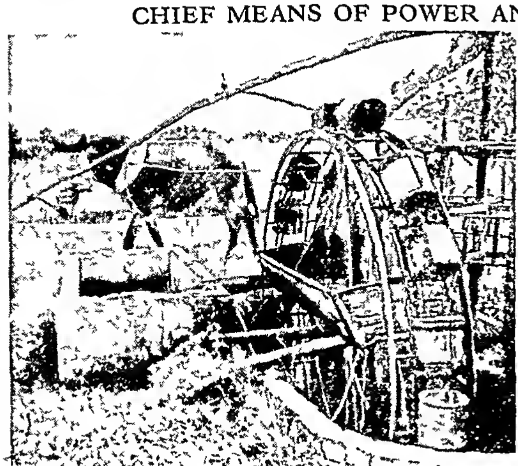
There is no "typical Spaniard." Spaniards of different regions differ in traits, customs, and language. Spanish, the national language of Spain, comes from the spoken Latin of the Romans—a "Romance" language. The five general regions of differences are Castile, Andalusia, Galicia, the "Basque country," and Catalonia. The people of Castile, on the Meseta, are usually thought of as the "true Spaniards." The educated Castilian is poised, sensitive, courtly, gracious, very individualistic, and intensely proud. Castilian Spanish is the literary language of Spain and the Spanish usually taught in the United States and in the diplomatic service.

The people of Andalusia, on the sunny south coast, are gayer and quicker to show their feelings. They have more Jewish and Moorish blood, and speak an Andalusian dialect of Spanish. On the damp, temperate northern coast the people of Galicia, called Gallegos, are hardworking, frugal, and somewhat stolid Their language mingles Portuguese with Spanish.

The three Basque provinces are almost a world apart from Spain. Basque villages nestle on the northern coast line and in the Pyrenees. The sturdy, aloof people do not call themselves Spaniards, but Iberians, and speak a language of their own. Scholars have not been able to trace the origin of the strange, agglutinative Basque language. It is gradually giving way to Spanish, especially in the cities.

The people of Catalonia live along the northeast coast, on the Mediterranean. Despite its easy climate, Catalonians are practical and relatively brisk. They form the hard core of Spanish business and industry. Unlike the easy-going Andalusians and elegant Castilians, they have small use for *mañana* —"put it off till tomorrow." Catalonian workers stoutly fought for the socialistic Republic in Spain's civil war. Time and again, Catalonia has demanded an autonomy. The

CHIEF MEANS OF POWER AND TRANSPORT



The strong, blindfolded mule (left) treads a monotonous circle to lift water from a well on a parched Spanish plain. Oxen (right) pull enormous loads, such as these hay stacks. Mules and oxen are well suited to living in the dry Mediterranean lands.

Catalonian language is a branch of the old Provençal dialect of France.

Despite differences in language and traits, the people of Spain have common ties that make them "Spaniards." They all have intense individualism, almost reckless bravery, stiff pride, and good manners. Even many of the very poor have an air of personal dignity.

The population is sparse. It varies from only 41 persons to the square mile in Soria province to 749 in Barcelona province. The national density rate is only 147 persons to the square mile, one of the thinnest in Europe.

THRESHING IS FAMILY TASK ON SMALL FARMS

These are threshing grounds on the Meseta. In the foreground, a father rakes the cut wheat. His daughter drives the mule over the sheaves while the small son rides the drag. Later, the wheat will be winnowed by hand.

Religion and Education

The Spanish people are traditionally Roman Catholic. The short-lived Republic separated the church from the state and took over the church's properties. When the Nationalists won control in 1939 they restored the Catholic church as the national faith and gave back its properties. There are relatively only a handful of Protestants and Jews, and their activities are restricted to worship within their few churches and temples. They are not permitted to hold public ceremonies.

Despite a law of free and compulsory education, Spain is one of the most illiterate of European nations. About a fifth of the Spaniards over the age of five cannot read or write. This is largely due to too few schools and the lack of busses and other transportation to carry children to school centers. The Republic built hundreds of schools, but many more are needed. All children are supposed to go to school until they are 14 years of age.

Today the Roman Catholic church is again in charge of many of the schools, and religious teaching is part of the course of study. Spain has 12 universities, several of them centuries old. The universities of Granada, Salamanca, and Zaragoza are celebrated schools. The universities are centers for Spain's 12 educational districts.

How the People Live

Most Spaniards get their living from the land, and growing enough to eat is a constant struggle. Spanish farm experts say that only about 10 per cent of Spain is "first class" agricultural land; about 10 per cent is too rocky to use; about 35 per cent is almost worthless because it lies at very high altitudes, is extremely dry, or has very poor soil. The remaining 45 per cent is only moderately good for crops. About 32 per cent of the total is cultivated.

Spain has a number of large landowners, but many of the people own their own small farms. Near Bar-

PRESSING TIME FOR WINE GRAPES

Grapes, which need little water, are one of the chief crops in Mediterranean lands. Most of the crop is made into wine. At left, men in hobnail boots trample grapes in a rural press. At right, is a scene from a fete day opening the pressing season in southern Spain. Girls in traditional costume carry grapes to a press set beside the cathedral for a blessing of the harvest.

STURDY VILLAGE ON THE BLEAK PLATEAU

On the treeless Meseta, homes are of stone and adobe. Even aged peasant women are rarely idle. These women are sewing in the warm sun.

celona and on the Atlantic coast many families live in farmhouses surrounded by their fields as they do in the United States. But on the Meseta, where two thirds of Spain's farms are located, the farmers live in villages, several miles from their fields. They are sociable people and like to live close together and do their work in groups, even in the farm fields.

Villages are usually from 10 to 20 miles apart. The squat little houses and barns are built of adobe or stone, huddled together and almost windowless to keep out the summer heat and sharp winter cold. The floors are usually clay tile and swept clean. The family spends most of its free time in the kitchen, which has only a few handmade chairs, a table, and perhaps a chest. From the center of the low ceiling usually hangs an electric-light bulb, for almost all Spanish homes have electric lights. From the beams dangle strings of garlic, onions, and peppers.

Bread is actually the "staff of life" in Spain, in the cities as well as in the villages. At every meal each member of a farm family has half a loaf of wheat bread at his plate. For the rest of the meal, three times a day, he usually has potatoes, olives, beans, cheese, and wine. Occasionally, for celebrations, the family has meat, usually chicken in rice.

Early in the morning the men and boys ride their oxen or mules to the fields. Those who do not own their own farms earn the equivalent of 50 cents a day, and this is paid partly in produce, such as beans. At home the women and girls make clothes, tend chickens, and make cheese from the milk of sheep or goats. The Meseta has few cows

Since almost all the field work is done slowly by hand, with the aid of mules and oxen, Spanish farmers work hard and long. They do not get back home until long after dark. They have supper at about nine-thirty.

They Enjoy Games and Fiestas

Despite their hard work and their lack of such entertainment as motion pictures, radio, or television, the farmers have many good times. The boys play football and *pelota* (handball), the men gather in the village *cantina,* and the women and girls find time to gossip and visit—usually at the village well.

All dress in their best for the many holy days, when they rest from work and celebrate with a festive meal. Every village has its own church. At fiesta times many villagers wear their traditional costumes—the women gay in vivid, billowing skirts, bright bodices, flowered shawls, and queenly mantillas. Like the Spaniards of the cities, they love to step the old folk dances, such as the *bolero* and *flamenco,* snapping castanets or keeping the rhythm of guitars. Everyone sings the Spanish folk music—some tunes are lilting, some haunting in minor keys, others almost frenzied in their exciting rhythm.

SMALL COUNTRY INN

The rough plaster walls and stone floor are cool *in summer and warmed by an open fire in winter.* Even the simplest rural inns have a friendly air.

Life in the Cities

Like the villagers, people in Spanish cities love color, music, dancing, and beauty. Even the largest cities, such as Madrid and Barcelona, cherish traditional customs, such as fiestas, carnivals, and elaborate processions on church holy days.

As in most countries, the larger cities have their wealthy, poor, and middle classes. The poor are piteously poor. Nearly always struggling against starvation, they live in wretched tenements, sagging huts, and even caves.

The rich sections of the cities are world-famous for their beauty. The stately white

homes have magnificently wrought iron grille balconies and flowering window boxes. Instead of having "front yards," the houses open on the rear into *patios*, or enclosed courtyards, where roses, camellias, or other graceful flowers bloom and fountains cool the air. All the homes and even new apartment buildings have shutters to keep out the glaring summer sun and heat.

To escape the worst of the heat, most shops and offices close for part of the afternoon. Concerts and plays do not start until very late at night, for dinner is served from 8:30 to 10:30 P.M. Usually the food is not highly seasoned, but nearly all is cooked in olive oil. Wine is the universal beverage. (*See also* Barcelona; Madrid; Seville; Valencia.)

Every large city and nearly every town has a ring for bull fighting. To most foreigners, this "national sport of Spain" is cruel and repulsive. The Spanish do not regard it as a sport. They admire bull fighting as a test of bravery, skill, and grace performed under traditional rules of formality.

Spaniards are adopting the sports of other nations. Football (Rugby) is particularly popular. The football stadium in Madrid seats 80,000 people. The bull ring has seats for only 25,000 people.

Spain's Golden Heritage of Culture

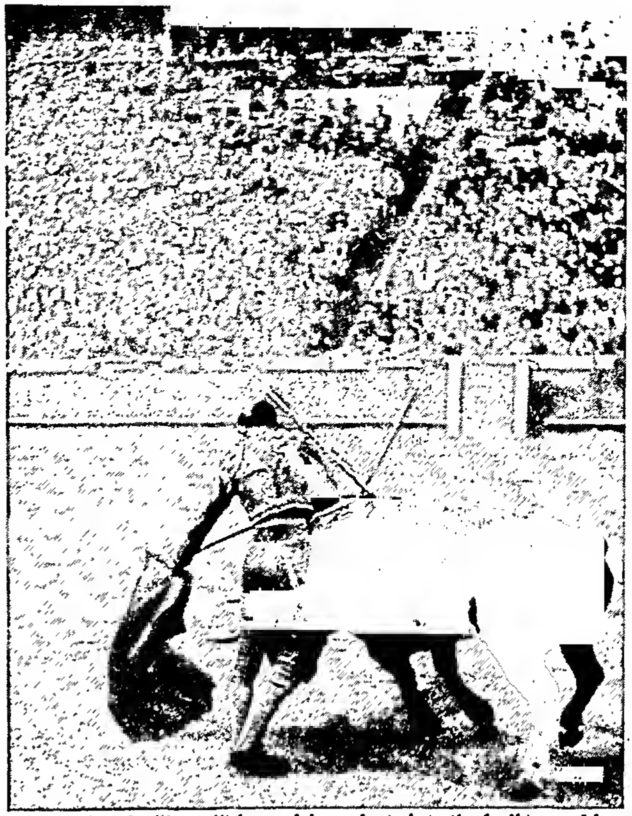
Beauty literally crowds Spain's great museums, cathedrals, and monasteries. Spanish kings collected masterpieces of art from all Europe, but none surpassed the great works of Spain's own painters—Murillo, Velasquez, and Goya (*see* Murillo; Velasquez). Greek-born El Greco is also considered a Spanish painter, because he did his greatest work in Toledo. The Prado museum in Madrid draws visitors from all over the world. The cathedrals are exceedingly ornate in baroque style. Several were designed by Flemish, Dutch, and German architects.

Spain has also developed notable writers. The 'Don Quixote' of Cervantes has been translated into nearly all major languages. Lopé and Calderon wrote brilliant plays, and Unamuno became an inspiring philosopher. (*See also* Spanish Literature.)

Transportation and Communication

Poor transportation has handicapped Spain. Because it is so mountainous, Spain can build highways and railroads only at great expense. A railroad often has to travel more than two miles up, down, around, and through tunnels to cover one mile as the crow flies. Rail communication with the rest of Europe is further handicapped because the Spanish rails are laid wider than the European standard to hinder invasion by possible foes. This difference in gauge makes it necessary to reload trains at the French border.

DRAMA OF THE BULL FIGHT



Aides ("banderilleros") have driven darts into the bull to madden him. Here the matador, with cape and sword, prepares for the kill.

SPAIN FAMED FOR DANCES

Costumed girls dance in a street in Seville as bystanders clap time to the rhythm of castanets.

Today Spain has about 11,000 miles of railroads, mostly government-owned. The larger cities also have electric lines into the nearby countryside. Madrid and Barcelona have subways. Airlines connect all the large cities and link Spain with other nations.

National highways total about 80,000 miles, and there are some 6,000 miles of provincial roads. Spain's chief means of transportation is still the ox and mule.

Spain has a relatively large number of telephones, over 600,000. The system was developed by specialists from the United States. Radio and telegraph also serve the cities.

Agriculture in Spain

Farming follows the pattern of Spain's varied land and varied climate. The chief crops are wheat, olives, barley, oats, rye, potatoes, oranges, rice, beans, grapes (for wine), and honey.

Farmers on the Meseta dry-farm as did the Roman colonists some 2,000 years ago. They let part of their fields lie fallow for a year, but work them with a shallow plow to leave

the stubble on the surface. This cover helps to store the scanty moisture.

Spain's dry farming has been called backward, because it "wastes" man power and yields thin crops; but some experts say that these practices get the most from the parched soil, for they conserve moisture. Large-scale irrigation of the Meseta is almost impossible, as the rivers have little water and their valleys are far below the surface of the fields.

Few Meseta farmers have tractors. Their farms are small and the soil needs manure from the oxen and mules for fertilizer. Getting enough fertilizer is a grave problem for Spain's peasant farmers. Few can afford to buy nitrate fertilizers from abroad.

On the extremely dry sections of the Meseta, especially in New Castile, shepherds guard great flocks of heavy-fleeced Merino sheep. This breed has been imported by most European countries and by the United States (*see* Sheep). Large flocks also graze the moors of the rugged Estramadura region and the mountains of the Basque country. Basque shepherds are so skilled and so accustomed to lonely living that many sheep ranchers in the United States bring them here to tend flocks on the western ranges.

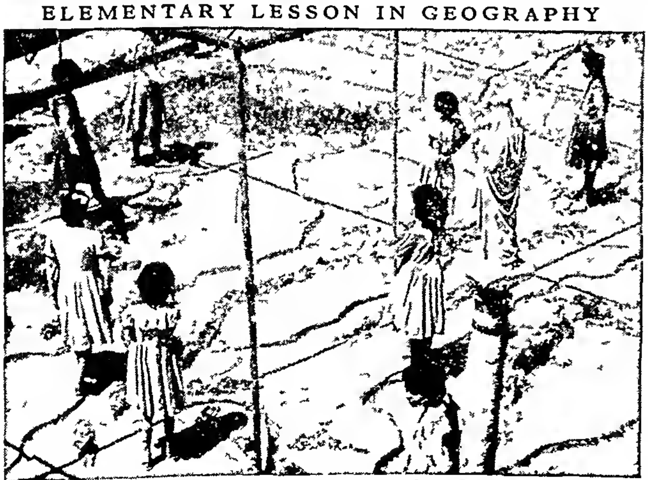
PEOPLE CELEBRATE MANY HOLY DAYS

A flower-filled float bears a richly decorated religious statue in the Corpus Christi procession in Seville. Even villages have elaborate festivals.

Farms in the North and on the Mediterranean

Northern Spain grows corn and barley chiefly, and raises cattle on the well-watered grazing land. South of the mountain wall, acres of olive trees dot the drier slopes. Many groves are centuries old.

ELEMENTARY LESSON IN GEOGRAPHY



In the yard of a Catholic school Spanish girls learn the lay of the Spanish land by walking over a huge relief map. *The ridges in the center enclose the Meseta.* Notice how deep are its river valleys.

The southeastern Mediterranean coast is the "gardenland" of Spain. Here the Moors overcame the dry climate by building extensive irrigation systems. Valencia is the center of the fertile region (*see* Valencia). In an almost unbroken chain of *huertas* (from the Latin, *hortus* "garden") grow almonds, oranges, lemons, figs, dates, melons, pomegranates, and some sugar cane. Mulberries also thrive, contributing to the silk industry of Valencia. From this region come two famous wines—malaga and sherry, named from the cities Malaga and Jerez

Northeastward, toward Barcelona, the Ebro River has enough flow to supply an irrigation network. Farms in this cooler area raise potatoes, grains, pimentos, sugar beets, fruits, and olives.

Wealth of Minerals

Next to agriculture, mining is Spain's chief industry Its mountains yield an amazing variety of minerals. They include copper, iron, coal, lead, manganese, zinc, antimony, tin, sulfur, wolfram, and potash. Spain has the world's largest deposits of mercury. It exports most of its minerals, for it has little heavy industry.

Its coal reserves are vast, yet it does not mine enough for its own needs. This is partly because of the great cost of rail freight from the mines. They are chiefly in the north—in Asturias and the Basque country. Water transport from Wales is cheaper.

Manufacturing Is Not Extensive

Except for Barcelona, Spain has no real industrial cities. The Ebro River, swiftly flowing down from the Pyrenees, supplies the Barcelona region with hydroelectric power. The region also enjoys the advantage of Barcelona's fine, deep-water port This enables industries to import bulky raw materials by water at cheap rates. The Barcelona region manufactures chiefly textiles, machinery, glass, chemicals, leather goods, and furniture.

In Asturias there is some chemical and metallurgical industry. Madrid manufactures chemicals, cork products, leather, and pottery. Seville produces cork and tobacco, soap, and chocolate. A few other cities have glass factories, paper mills, and tanneries. There are many small fish canneries for Spain's catch of sardines and cod.

History and Art Are City Assets

In recent years Spain has developed a considerable tourist industry. The government provides a central agency to aid visitors. The agency has even built attractive inns, like de luxe motels, at convenient intervals along the highways.

THE WHITE BUILDINGS OF CADIZ, CITY OF THE SEA

Founded by the Phoenicians, Cadiz is southern Spain's door to the Atlantic Ocean. Stone seawalls protect it on three sides from the surf. The fourth, the part of the city shown here, faces a sheltered bay. Cool breezes stir the palm trees in the patios and many parks of Cadiz. The Renaissance style church in the background is the New Cathedral, begun in 1722.

Spain fascinates tourists. Cities rich in history and art rise in stately pride from the gaunt, sun-bright Meseta. Toledo, once the capital of Spain, stands on a giant ridge of granite, surrounded on three sides by the Tagus River and on the other by a medieval wall. Crowning the summit is the Alcazar, begun as a Roman palace and then taken over by the kings of Spain. During the Civil War, 1936–39, the Nationalists defended it for weeks under a blasting siege. The great Gothic cathedral, begun in the 13th century, is the seat of the primate of Spain. Other churches display treasures of silver and gold decorations and paintings by El Greco. The streets and buildings of Toledo keep the character of the Moorish founders.

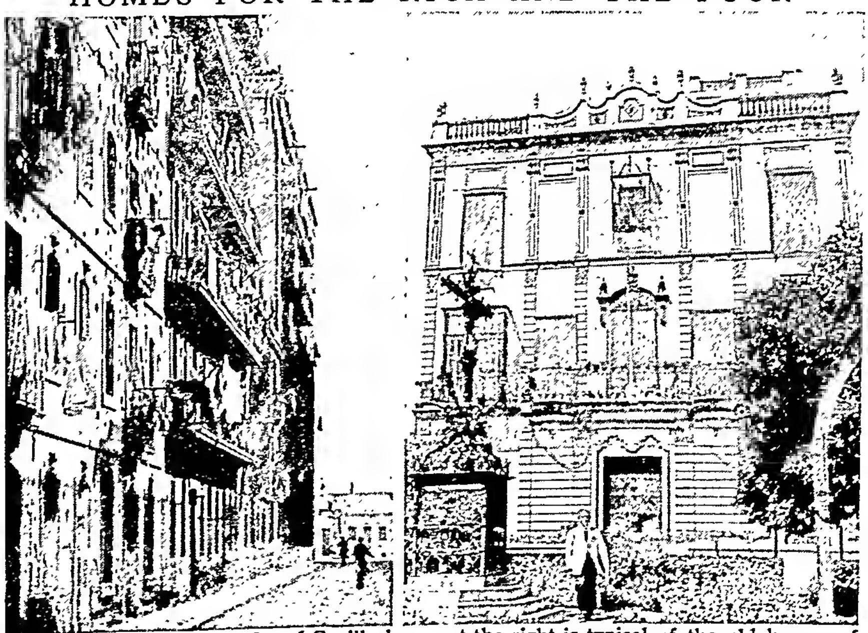
Moorish Castles, Churches

Zaragoza, once capital of Aragon, is a flourishing modern trade center, but it also has its Moorish castles and Gothic churches. Its famed university was founded in 1474. Salamanca is the oldest and most famous of Spain's university towns. In 217 B.C. Salamanca was captured by Hannibal. Its university was founded about 1215 by Alfonso IX of Leon and introduced Arabic learning into Europe.

Burgos, at the foot of a mountain, has the most elaborate Gothic cathedral in all Spain. The great 13th-century church shelters the remains of the Cid, the heroic Spanish warrior who championed Christianity against the Moors in the 11th century.

San Sebastian, on the Bay of Biscay near the border of France, is an old Roman town. It is attractive chiefly as a summer resort. Its beaches and mineral springs make it one of Europe's famed "watering places." Spanish kings moved there in summer to

HOMES FOR THE RICH AND THE POOR



The stately, elegantly designed Seville house at the right is typical of the old homes of Spanish grandees. The matted window hangings keep out the burning sunlight. At left, Barcelona tenements open on a cobbled street. They too have sun mats.

VALENCIA, QUEEN CITY OF ANDALUSIA

This old Grecian-Moorish city in Andalusia, in southern Spain, is a favorite of tourists. Though it has become modern and progressive, it has kept its gay costumes and festivals. *In spring it is fragrant with orange blossoms.*

town and visited only for its cathedral, originally a Moorish mosque.

Cadiz and the Balearics

Cadiz, on the southern tip of Spain on the Atlantic coast, is said to be the oldest town of continuous existence in Europe. The Phoenicians founded it about 1100 B.C., and it was an important city for thousands of years. In the 18th century it held the monopoly of trade with Spanish America. Today it is noted chiefly for its beauty, sea bathing, and superb climate.

The coastal mountains of eastern Spain dip under the Mediterranean and then rise again to form the Balearic Islands of Spain. The beautiful little Balearics have long attracted tourists (*see* Balearic Islands).

Spain's Early History

The pageant of Spain's history is as picturesque and as full of contrasts as the country itself. As early as 1100 B.C. the Phoenicians sailed their tiny ships to Spain, seeking its iron and tin. About 500 B.C. Carthage colonized the

Miramar Palace, as does the government today. Tourists also enjoy the colorful old fishing quarter.

The southern provinces are known as Andalusia. This is the region usually called "sunny Spain"—a land of lush fruits, music, and gypsy dancing. Here is Granada, splendid capital of the Moorish province which held out 200 years after the Moors had been driven from the rest of Spain. Once a city of 400,000 people, it has now declined to about 153,000 (including its suburbs); but it is one of Spain's most picturesque cities.

The Moorish Alhambra

Granada surmounts two hills. In its 16th-century Renaissance cathedral are the tombs of Ferdinand and Isabella. In Granada is the magnificent Alhambra, the most perfect example of Moorish art remaining in Europe. Begun in the 12th century, it was both palace and fortress (*see* Alhambra). Most Andalusian cities have magnificent fountains dating from the days of Moorish irrigation, but those of Granada seem to be especially cooling and musical.

Córdoba, or Córdova, once was one of the world's great commercial centers. It won fame for the fine, soft cordovan leather. Today it is a slumbering

ONCE SPAIN'S CAPITAL

The fine old houses of Córdoba seem to sleep in the Mediterranean sun. Superb iron grilles enclose the balconies and frame the windows.

land and held it until Rome's galleys and armies drove out the Carthaginians in 201 B.C. Then came six centuries of Roman colonization and government. During that time most of the Spanish cities were founded, and Spain grew to nearly three times the population it has today. Two Roman emperors, Trajan and Hadrian, were Spanish-born; and Spain contributed nearly all the more notable writers of the "silver age" of Latin literature (*see* Latin Literature).

In the 5th century A.D. began 300 years of Spain's subjection to Teutonic barbarian tribes. The land was invaded by the Suevi, Alans, and Vandals. In 415 Rome sent the Visigoths, another powerful Teutonic tribe, to regain Spain for the empire. The Visigoths killed or pushed back most of the horde, but some Vandals reached Andalusia—giving their name to that region, *Vandalusia*. The Visigoths ruled Spain from 415 to 711.

Moorish Invasion

The Visigoths reigned until the great battle of Jerez de la Frontera (Jerez of the Frontier) in 711 when Moorish invaders from Africa overthrew the Goths. This established the Mohammedan power which lasted in Spain for seven centuries.

The Moorish period in Spanish history is almost richer than that of the Roman colonization. Their splendid irrigation projects made a garden land out of the arid coastlands and southern hills of Spain. They rebuilt the old Roman cities on Arabic lines, with graceful palaces and vast mosques with domes and minarets. Fine metalwork and silk and leather goods, as beautiful as any from the Orient, came out of Spain; and a Toledo blade became as desirable as one from famed Damascus.

Christian Kingdoms Expel Moors

Christian kingdoms, meanwhile, were forming in the northern mountains and nibbling bit by bit at the Moorish provinces. The kingdom of Asturias on the Bay of Biscay, which later expanded into the kingdom of Leon and Castile, was the birthplace of Spanish liberty. Almost from the beginning of the Moorish invasion, Asturias struck back at the Mohammedans.

Later it was joined by Aragon, Navarre, Catalonia, and Portugal. Together they waged the long battle to "free Spain from the infidel." In the battle of the plains of Tolosa in 1212, the combined kingdom of Leon and Castile practically broke the Moorish power and restricted the remnant to the small Mohammedan kingdom of Granada in south Spain.

From this period come the great tales of chivalry, among them the songs and stories of the gallant Christian knight called the Cid ("commander"). His true name was Rodrigo Ruy Diaz de Bivar. In the 11th century he performed deeds of prowess for the king of Castile.

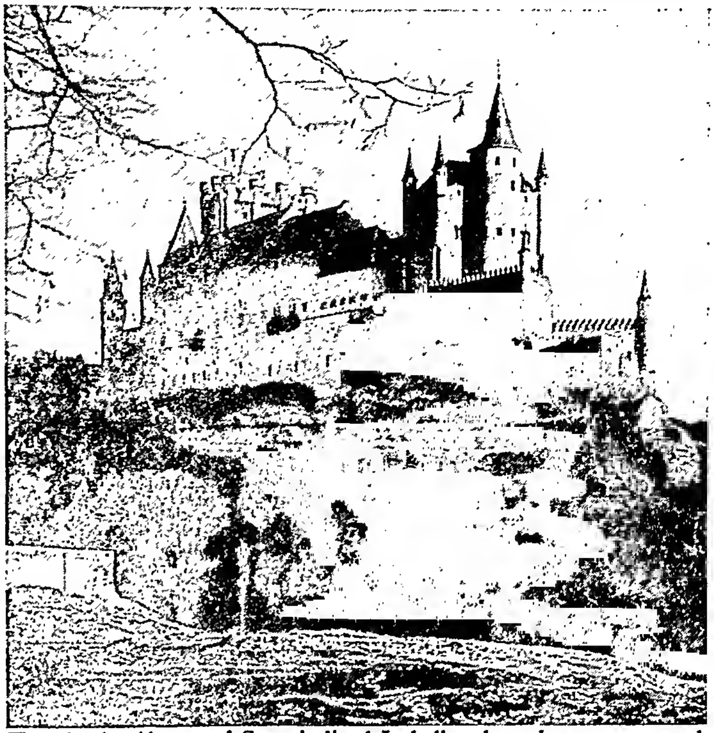
Ferdinand and Isabella Unite Spain

In 1469 the marriage of Ferdinand of Aragon and Isabella of Castile united most of Spain under a single rule. The final blow at Moorish power in Spain came through the conquest of Granada in 1492—the year that Columbus gave the New World to the crown of Spain. In 1512 the Spanish part of Navarre was conquered. Philip II seized Portugal in 1580, and Spain held it for 60 years. Only the tiny state of Andorra in the Pyrenees remained free.

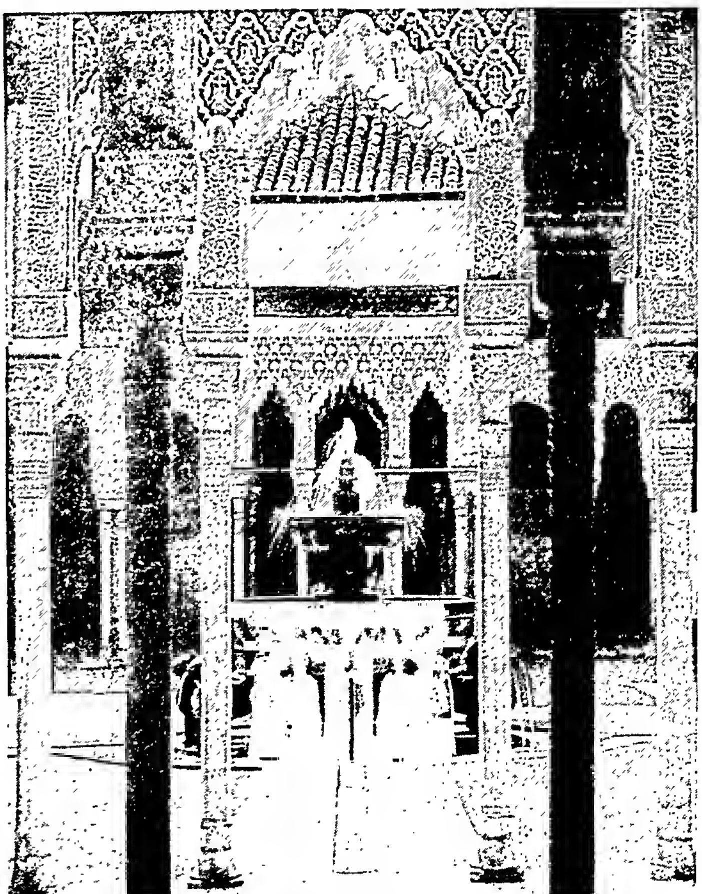
The grandson of Ferdinand and Isabella became the most powerful ruler in Europe. He was Charles I of Spain, better known as Charles V, Holy Roman Emperor. In the reign of Charles, Spain became mistress of nearly half the world. Charles ruled Spain, Naples and Sicily, the duchy of Milan, and the Netherlands, and was the imperial lord of Germany as well as of the treasure lands of the New World (*see* Charles V, Holy Roman Emperor).

Under his son, Philip II, Spain championed Catholicism against the march of the Protestant Reformation (*see* Reformation). Tragically, Spain spread the old institution of the Inquisition (*see* Inquisition). Many Jews and Moors were expelled. Protestants and even "heretical"

MASTERPIECES OF ARCHITECTURE

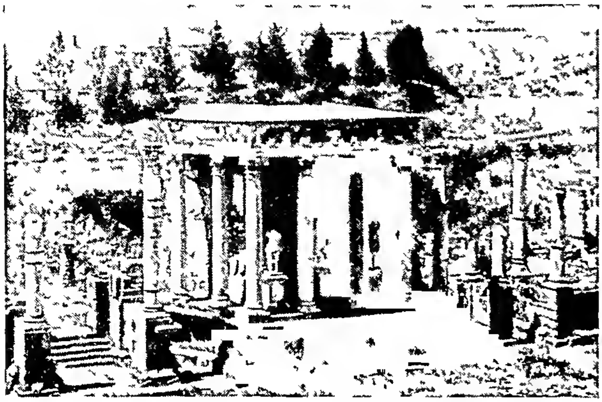


Here in the Alcazar of Segovia lived Isabella when she was crowned queen of Castile. Built in the 11th century for the rulers of Spain, it has been called the perfect type of medieval Spanish castle.



This Court of the Lions, with its playing fountain, is only one of many jewellike courts of the Alhambra in Granada. Visitors from all over the world come to enjoy the splendor of this Moorish palace.

ROMANS BUILT THIS THEATER



These ruins rise from the Estremadura plain at Merida. Built in the reign of Augustus, the theater seated 5,000.

Catholic Spaniards were tortured and burned at the stake in *auto-da-fe*, "act of faith." The persecution crushed the Spanish people's initiative and freedom of thought. At the same time Philip tried to stamp out Protestantism abroad by attempting to conquer Protestant England. Sir Francis Drake's defeat of Philip's mighty invasion fleet smashed Spain's rule of the seas (*see* Armada, Spanish). Philip's futile and costly efforts at conquest permanently hurt the resources of the Spanish kingdom.

The Decline of Once-Mighty Spain

After the time of Philip II Spain steadily declined in power and riches. The final expulsion of the Moors in 1608–9 by his son, Philip III, seriously weakened Spain, because the Moors had been energetic builders and businessmen. The death of Charles II in 1700 ended the Hapsburg line of Spanish kings, and most of Europe fought for the vacant throne in the War of the Spanish Succession, 1701–14.

The war stripped Spain of most of its outlying possessions in Europe and seated a French Bourbon prince on the throne as Philip V. From 1714 to the outbreak of the French Revolution, Spain was little more than a satellite of France. In 1808 Napoleon placed his brother Joseph on the throne of Spain. The outraged Spaniards revolted. Aided by the British, they freed Spain from Bonaparte's rule in the Peninsular War, 1808–14. Meantime, in 1812, Spain adopted a liberal constitution, but when Ferdinand VII ascended the throne he abolished it. By the end of his reign in 1833 Spain had lost all its vast empire in the New World except Cuba and Puerto Rico, and these were lost in the Spanish-American War of 1898. The war also cost Spain the Philippines.

Spain Works Toward Liberal Government

As the old Spain—the Spain of grandees and absolute royal power—declined, a new and more liberal Spain was struggling forward. Conflicts between liberals and reactionaries brought years of revolutionary movements interspersed with periods of constitutional government. From 1873 to 1875 Spain was a republic, but in 1875 the Bourbon monarchy was restored to power when Alfonso XII ascended the throne. In 1876 a new constitution was adopted.

The struggle for democratic, or even constitutional, government was especially difficult in Spain, because the Spanish people had their own regional interests. The Spaniard is an individualist and does not relish centralized power. He is, moreover, more devoted to his native region, such as Catalonia or Andalusia, than he is to Spain as a whole.

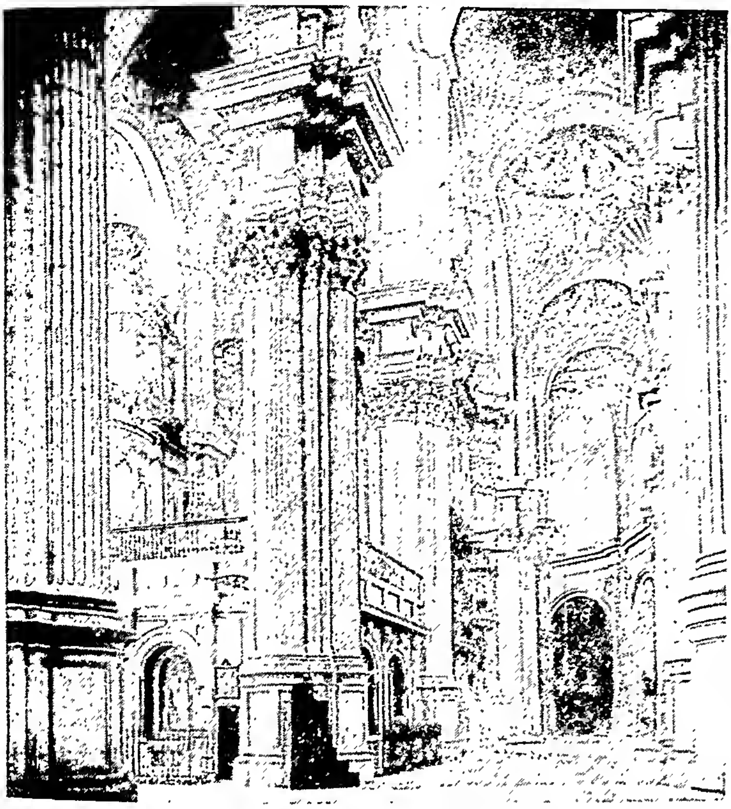
First World War and Dictatorship

During the first World War Spain was neutral. This stimulated its few industries, as it sold supplies to the Allied nations. Peace brought the loss of foreign markets and Spain fell into economic depression. The weak Bourbon government of Alfonso XIII could not cope with it nor put down an old, costly rebellion in Spanish Morocco. In 1923 General Primo de Rivera, with Alfonso's consent, seized power and set up a fascist form of government. He made many improvements, but the world depression in 1929 again plunged Spain into near-poverty. De Rivera resigned

ELABORATE MEMORIALS OF SPAIN'S MAGNIFICENT PAST

At left, is the frescoed library of the great Escorial, the summer palace of Spanish kings—and their tomb. An astrolabe stands before cases of rare books. At right, in the cathedral of Seville, is the tomb which Spaniards believe holds Columbus' bones.

MALAGA'S WHITE CATHEDRAL



The great vaulted cathedral of Malaga was begun in 1538. It is on the site of a Moorish mosque. Nearly every large Spanish town has a cathedral.

in 1930. Opposition to the dictatorship shifted to dislike of the monarchy. Republican parties overwhelmingly won the elections in 1931. Alfonso went into exile (*see* Alfonso).

Spain Becomes a Republic

A provisional republican government, under President Niceto Alcalá-Zamora, took control. A new liberal constitution was adopted. It separated the church from the state. The republic began many reforms.

At the start of the republic nearly half the Spanish people could not read or write. Poverty was widespread, and industrial wages were low. In Madrid many workers had become Socialists. In Barcelona many had turned to anarchism and to syndicalism, which aims at putting workers' organizations in control of all industries.

The republic struggled to reconcile the conflicting movements and push its reforms, but it had little influence or money. In 1936 the many leftist parties united in a "Popular Front" and overwhelmed the conservatives and moderate liberals in the national vote.

Civil War Engulfs Spain, 1936–39

Civil war followed within a few weeks. The rebels, who called themselves the Nationalists, were the conservatives and the Spanish army. The defenders were the republic and the workers, called the Loyalists. Led by Gen. Francisco Franco, the rebels swept to Madrid, but a hastily organized, sturdy Loyalist militia held it until the end of the war (*see* Franco). From the start the war was incredibly fierce, with fanatical cruelty on both sides.

The conflict has been called a "training ground for the second World War," because other nations took part and tried new military tactics. Nazi Germany and fascist Italy sent "volunteer" troops to the rebels and supplied them with arms and planes. Communist Russia aided the Loyalists with arms and technical experts and recruited an "international brigade."

The war ended March 28, 1939, when starving Madrid gave up. It was estimated that the savage conflict had cost Spain more than 1,000,000 lives, about 700,000 wounded, and some 40 billion dollars.

Spain Becomes Fascist

The victorious Nationalist leader, General Franco, then established Spain as a fascist dictatorship and restored the Roman Catholic church. As El Caudillo (the leader) he headed the Falange (phalanx) and banned all other political parties. He put industry under national syndicalism. Franco ruled Spain by decree until 1942 when he re-established the Cortes (parliament), which he continued to dominate as "chief of the state."

In the second World War, Franco proclaimed Spain's neutrality, but gave undercover aid to Germany and Italy. On the pretext of keeping the international zone of Tangier neutral, Spain occupied the region. In 1945 it withdrew at the demand of the other powers (*see* Tangier). These unfriendly acts, combined with Franco's harsh rule, led the other countries to bar Spain from membership in the United Nations. The ban was relaxed in 1950 to admit it to the Food and Agricultural Organization of the U.N. This, of course, did not include full membership in the U.N.

Regency Council and Economic Problems

In 1947 a controlled plebiscite approved Franco's "Law of Succession." This established a regency council which, at the death of Franco, would name a king or regent. By a two-thirds vote of the Cortes, the king or regent would become ruler of Spain.

Franco somewhat lessened the harshness of his dictatorship, but severely restricted the Basques. In an effort to quell their rising demands for autonomy, he forbade their schools to teach the Basque language and banned newspapers in Basque. He also ordered that children be given Spanish Christian names instead of the traditional Basque names.

Under Franco, Spain made some economic progress, but recovery from the ruinous civil war was slow. Factories, railroads, and shipping all needed quantities of new equipment. Housing was an especially grave problem, for thousands of homes had been destroyed in the war. High living costs drove workers, especially in Barcelona, to rioting. Franco sought economic aid from other nations. The United States considered Spain a key to Europe's defense against Communism and, in 1951, sent economic assistance.

THE WAR THAT BLED SPAIN AND BROUGHT FASCIST DICTATORSHIP

These Estremadura civilians are typical of the determined Loyalist militia in the civil war. The "range finder" is homemade.

Superbly equipped German Condor Legion "volunteers" march through Gijo to support Franco's Nationalists.

The victor, Franco, center in the reviewing stand, raises hand in fascist salute to his triumphant armies in May 1939.

By 1953 the question of American air and naval bases in Spain hinged on further economic aid. The Franco government pointed out that it had taken steps to rehabilitate the stricken country, but needed outside help to complete its colonization program that had been established by the Ministry of Agriculture. The program aimed to put some 900,000 acres of Spain's land into production by irrigation and soil control.

To qualify as settlers on the new land, Spaniards attend the Institute of Colonization's schools of agriculture. They then receive two cows, one horse, a sow, fertilizers, seeds, and implements. They live in one of the some 30 new villages. Their increased crop production usually enables the settlers to repay the government in two or three years. Most of them expect to own their homes and land within 10 to 25 years.

United States Gets Military Bases

Late in 1953 the United States agreed to give Spain considerable economic and military aid in return for sites for air and naval bases. The United States planned to build a naval port and air base near Cadiz and an aviation fuel pipeline from Cadiz to air fields near Madrid and Seville. It sent its first shipment of arms to Spain in 1954.

In 1954 Spain pressed its claim to Gibraltar, and radical young nationalists rioted in protest of a visit by Queen Elizabeth II to the British garrison on the Rock. The government arrested several of the leaders. Franco's regime also quickly put down riots by anarchists and monarchists.

REFERENCE-OUTLINE FOR STUDY OF SPAIN AND PORTUGAL

SPAIN

The Land and the People

I. **Location and size** S-311: location in the world, map W-204-5; in Europe, map E-416; political divisions map S-312
   A. **Island provinces**: Balearic Islands B-20, map S-312; Canary Islands C-110, maps A-42, A-452
   B. **Possessions in Africa**: Spanish Morocco M-393 and Fact-Index, map A-167; Spanish West Africa, Spanish Guinea (Fact-Index), map A-42

II. **Structure of the land** S-311-13, E-430, list S-311, maps S-312, E-419, pictures S-313, 314, 316
   A. **Mountains and central plateau (Meseta)** S-312, list S-311, picture S-314: Pyrenees P-447, E-422, picture S-313
   B. **Rivers and lakes** S-312-13, list S-311
   C. **Coast line** S-311, pictures S-313, 314: Gibraltar G-107

III. **Climate** S-313: rain, map E-420

IV. **Plants and animals** S-313: vegetation, map E-420

V. **People** S-313-15: Basques S-314, picture F-192b; Moriscos (Moors) M-389
   A. **Population** S-315, list S-311: distribution, map E-419
   B. **Emigration to the United States**, chart I-46

VI. **How the people live** S-315-17: food S-316, 317; clothing S-316, pictures S-314, 315, 316, 317; shelter S-316-17, pictures S-314, 316, 319
   A. **Farm and village life** S-315-16, pictures S-314 315, 316
   B. **City life** S-316-17, pictures S-319: Madrid M-27-8, picture M-26
   C. **Religion and education** S-315, pictures S-318
   D. **Games, fiestas, and holidays** S-316: bull fighting S-317, picture S-317; Christmas C-295, folk dancing F-192c, picture F-192b

VII. **Resources and industries**, list S-311
   A. **Agriculture** S-315, 317–18, V-434: lemon L-161; olive O-378; orange O-400, grape (raisin) R-72, pictures S-313, 315; wheat, picture S-315; rice R-149
   B. **Minerals and mining** S-318, P-447, map E-429d: copper C-473; mercury M-173
   C. **Fisheries**, picture S-314
   D. **Sheep raising** S-318, S-137, picture S-314
   E. **Manufacturing** S-318, M-28, B-54, V-435, S-109

VIII. **Trade**: exports and imports, see Trade table in Fact-Index

IX. **Transportation and communication** S-317

C. Christopher Columbus in Portugal C-417, 418
D. Spain and Portugal divide New World (1493-94) A-188, M-31-2
E. Vasco da Gama G-7-8: discovers Mozambique M-442; reaches India and Orient I-67-8, A-188
F. Explorations in the Americas A-188, 190: Brazil claimed and colonized B-293; Newfoundland coast reached by Corte-Real A-190
G. Disputed claim to Spice Islands M-31-2, A-188-9
H. Far East explorations: Ceylon C-180; East Indies E-208; Japan J-319; Malaya M-60

III. Decline of the Portuguese empire P-380-1
A. Throne seized by Phillip II of Spain (1581); but independence regained in 1640 P-380, P-191
B. Commercial-political alliance with England (Methuen Treaty of 1703) P-380-1
C. Lisbon earthquake (1755) L-266, E-196
D. Peninsular War with Napoleon (1808–14)—royal family flees to Brazil and establishes empire P-381, W-91, B-293: Brazil declares its independence in 1822 B-293
E. Revolution of 1910 and World War I P-381, L-266
F. Civil strife and military dictatorship P-381

IV. Salazar civilian dictator since 1933 P-381: neutral Portugal becomes wharf of Europe in World War II L-266, European Recovery Program and North Atlantic Treaty P-381

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SPANISH-AMERICAN WAR (1898). For years before the outbreak of the Spanish-American War over Cuba, the United States had tried to buy the island from Spain. As early as 1847 President Polk made an offer. Then in 1895, after nearly a century of misrule, bands of Cubans rebelled against Spain.

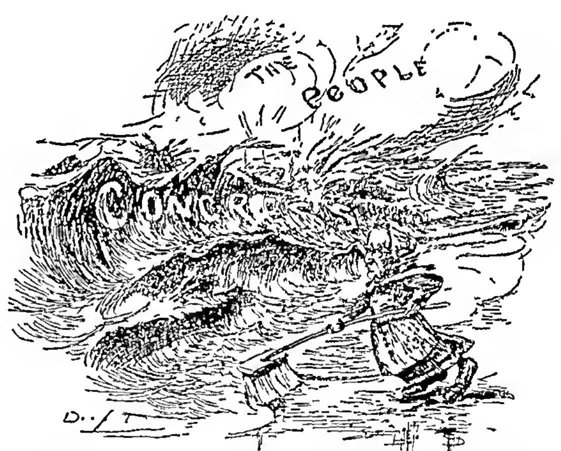
The Insurgents (rebels) began a reign of terror against the Loyalists, burning their homes and destroying their fields. In a brutal effort to restore order the Spanish army, under Gen. Valeriano Weyler, swept people from whole provinces—men, women, and children—into giant wire pens. Hundreds of *reconcentrados*, "concentrated ones," sickened and starved.

The outrages were horrible, but they were exaggerated by unscrupulous "yellow" newspapers in New York City and other cities. The press led many Americans away from their traditional unwillingness to interfere in the affairs of another country. A wide demand arose for forcible intervention to set Cuba free.

'Maine' Explosion Touches off War

President McKinley wanted no "jingoist" war. He called on Spain to ease its Cuban policy and met with some success. On the night of Feb. 15, 1898, however, an explosion sank the American battleship *Maine* in Havana harbor, killing 260 men. When the hull was raised in 1911, examination proved that the explosion was external; but no one could tell whether the Spaniards or Cuban patriots, seeking a cause for American intervention, were responsible.

In 1898, however, the "yellow" papers at once called the Spaniards guilty. American anger surged. The possibility of war was brought closer by publication of a private letter written by the Spanish minister in



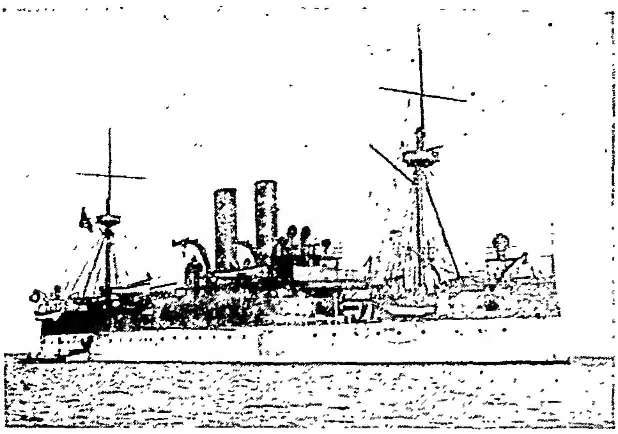
This cartoon, "Another Old Woman Tries to Sweep Back the Sea," ridicules McKinley's effort to halt demands for war with Spain. Drawn by H. C. Davenport, it appeared March 30, 1898.

Washington, De Lome, which disparaged McKinley. Although Republican leaders did not want war, McKinley yielded to the popular outcry, "Remember the Maine!" On April 11, 1898, he recommended to Congress that force be used to free Cuba. Congress agreed on April 19. War was declared April 25.

The war opened on the other side of the world. On May 1 Commodore George Dewey's squadron steamed into Manila Bay in the Philippines and destroyed the Spanish fleet (*see* Dewey).

To defend Cuba, Spain sent out a fleet under Admiral Pascual Cervera. An American blockade was so ineffective that he arrived safely in Santiago harbor, May 19. His fleet was in poor condition; but Rear

THE U.S.S. 'MAINE'



In January 1898, the *Maine* was sent to Havana on a "friendly visit," but really to protect Americans there if war broke out with Spain. Destruction of the *Maine* itself led to the war.

Admiral William T. Sampson, commander of the fleet, was not permitted to force a battle with Cervera. Sampson then asked for an army to reduce the Spanish forts that guarded Santiago's harbor.

The War Department sent about 16,000 men—mostly regular army troops—to Tampa, Fla., for embarkation to Cuba. Among the units was the First Volunteer Cavalry, raised by Leonard Wood and Theodore Roosevelt. They were called "Rough Riders," because many of the recruits were cowboys.

The entire force, under Gen. William R. Shafter, lacked proper food, medicine, arms, and supplies. Blame for the tragic inadequacies lay primarily upon Congress, as in time of peace it had not provided competent organization for military affairs.

The troops landed on the coast of Cuba in June. Cutting through tangled bush, during July 1–3 they attacked the Spaniards at El Caney and on Kettle Hill on San Juan ridge on the outskirts of Santiago.

As the Americans advanced, the Spanish authorities ordered Cervera's fleet to sea to avoid humiliating capture by an army. On Sunday morning, July 3, the Spanish fleet tried to run the blockade of the American squadron. In the four-hour battle every Spanish ship was sunk or beached. Only one American was killed—Chief Yeoman G. H. Ellis of the U.S.S. *Brooklyn*, flagship of Commodore Winfield S. Schley.

This naval victory of Santiago virtually ended the fighting. Santiago formally surrendered July 17. On July 25 an army commanded by Gen. Nelson A. Miles landed in Puerto Rico, almost unopposed. Spain submitted to an armistice on August 12. In the Philippines, however, word did not reach the command, and the army fought its only battle on August 13.

On Dec. 10, 1898, the peace treaty was signed at Paris. Spain gave up Cuba and ceded Puerto Rico, Guam, and the Philippines to the United States. In return, the United States paid Spain 20 million dollars for its colonial government buildings.

Casualties and Results of the War

The number of troops in service was 280,564, of whom 223,235 were volunteers; but most of the volunteers never left the United States. In the army, only 700 were killed in action or died of wounds; but 5,423 died of disease. The dreadful disease toll spurred the army into great advances in medical research, especially preventive medicine. Its work in fighting yellow fever, malaria, and other tropical scourges aided in building the Panama Canal.

The war showed need of a canal across the Isthmus of Panama. To join the blockading fleet in the Atlantic, the *Oregon* made a forced run from San Francisco through the Straits of Magellan to Key West. Remarkably fast though it was, the run took from March 19 to May 26. The Panama Canal was started soon after to provide quicker passage for naval vessels.

The acquisition of Spain's colonies made the United States an imperial power. In its new role, the nation faced growing obligations toward the world (*see* United States History, section 8).

The SOFT SPEECH *and* VIGOROUS LITERATURE *of* SPAIN

CERVANTES

UNAMUNO

SPANISH LITERATURE. Spain is divided by mountains into isolated valleys. The Pyrenees sever the country from close contact with the rest of Europe. Invasion and wars have set up hostile groups within the land. Naturally, the Spaniard has become individualistic, provincial, local, and conservative.

The Romans gave him his language, but it was the Iberians, Jews, Celts, Vandals, Visigoths, and Arabs as well, who gave him his character. It is this character—proud, dignified, mystic, gracious, elegant, and sometimes cruel—together with the isolation and wars of Spain, which have etched the traits of Spanish literature.

The language, an outgrowth of Latin, resulted in a less uniform speech in this divided country than its sister tongues, French and Italian. The literary tongue is Castilian, a dialect softened by Arabic. Catalonia has a language and a literature of its own.

The earliest known work in Spanish is 'El Cantar de Mío Cid' (Poem of the Cid), dating from 1140. The unknown writer left an epic poem crude in meter but full of the dignity and austerity of the hills of Spain. The "Cid" was Rodrigo Diaz de Bivar, who died in 1099. Though he had often helped Moslems against Christians, the poem presents him as a champion

of Christianity against the Moors, and leaves a graphic record of the life of the times.

Heroism and religion have long been the preoccupations of Spain, and many are the early religious and miracle-plays such as the 'El Auto de los reyes magos' (Mystery of the Magian Kings), a play of the Three Wise Men.

Spanish energies were sapped by eight centuries of struggle with the Moors, and the year 1492, when the Moors were expelled, saw the discovery of America, opening new outlets and interests to Spain. Little of the nation's vitality went into literature until the 17th century, the "golden age" of Spanish literature as it was of national glory.

WRITERS OF GAY COMEDIES

Lively dialogue and true Spanish humor are traits of the charming comedies, chiefly of Andalusian life, by the brothers, Serafín and Joaquín Álvarez Quintero.

In 1605 appeared the first part of 'Don Quixote', bringing fame to poverty-hounded Miguel de Cervantes Saavedra. Perhaps no book by a single author has been more widely read. Don Quixote on his spavined steed gave the final stroke to the false ideals of knight-errantry. Satire though it is, its most notable result was to project kindliness and human warmth into literature. (*See* Cervantes Saavedra, Miguel de.)

Two other attacks on hollow chivalry were made in Mateo Alemán's novels, 'Guzmán de Alfarache', and 'Atalaya de la vida umana' (The Watchtower of Human Life), the first of that purely Spanish invention, picaresque literature, dealing with the "pícaro," or rogue.

Four great dramatists appear in this same period. The two most famous are Lope Félix de Vega Carpio and Pedro Calderón de la Barca, better known as Lope and Calderón. The prolific Lope wrote his first play at the age of 12, tossed off over 1,000 plays and many epic poems. His rapid improvisations lack finish or subtlety, but glow with genius, in disproof of the old saw "genius is the capacity for taking pains." Lope, like Shakespeare, abandoned stilted forms for human reality. Cervantes called him "a monster of naturalness"

Calderón, on the other hand, might be called "a monster of ingenuity." At his best he surpasses Lope, but his style is as tiresomely lavish as baroque architecture, a mass of rhetoric and bombast. He is at his best in "cape-and-sword" plays such as 'La Dama duende' and 'Mañanas de abril y mayo'. His one great philosophical drama, 'La Vida es sueño' (Life is a Dream), retells an oriental story, 'The Awakened Sleeper'.

The third of the great dramatists, Gabriel Téllez, called Tirso de Molina, gained fame by dramatizing the old Don Juan legend in 'El Burlador de Sevilla y convidado de pietra', a play imitated by thousands.

The fourth dramatist is Juan Ruiz de Alarcón, a Mexican hunchback, student of Salamanca, and rich business man. Mocked for his deformity, he rebuked cruelty and other vices by presenting character types, a device adopted by Corneille and Molière.

When Spain's star declined as a nation, literature suffered a long eclipse, to recover somewhat in the 19th century. An outstanding novelist of the period is Benito Pérez Galdós, who wrote a brilliant series of historical novels. Pedro Antonio de Alarcón set the world laughing with his 'El Sombrero de tres picos' (The Three-Cornered Hat). An effective artist was José María de Pereda, who hated cities and the middle class, created fine peasant types, and preached patience and peace.

A FAVORITE OF THE NINETIES

José Echegaray, the Spanish mathematician and statesman who turned playwright and ruled the stage in the 90's, is shown in a portrait by Sorolla.

First Spanish writer to win the Nobel prize was José Echegaray, whose play 'El gran Galeoto' had a great success in Europe and America. A skilled technician, wise in stagecraft, he ruled the theater from 1873 to the 90's, but modern criticism finds him over-ingenious and windy. Modernism in writing was brought to Spain by a Nicaraguan poet, Rubén Darío, famous overnight for his poem 'Azul'.

A great awakening came in 1898 with the war which, strangely enough, left Spaniards and Americans better friends than before. Americans were attracted to Spanish art. Spaniards, realizing their backwardness, resolved to redeem the nation from "españolismo," dull indifference toward everything not Spanish. Ángel Ganivet and Joaquín Costa led this movement of "the generation of 1898," rewarded in a new flowering of literature.

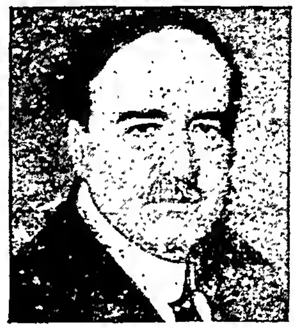

MADARIAGA

Ramón Pérez de Ayala has been called greatest of modern Spanish poets, with sensitive, melancholy Juan Ramón Jiménez perhaps second. King of the Spanish drama is Jacinto Benavente, winner of a Nobel prize in 1922. His tragedy of peasant life, 'La Malquerida' (The Passion Flower), was a tremendous American success in 1918. Delightful comedies were written by Serafín and Joaquín Álvarez Quintero, and delicate, poetic novels by another duo, Gregorio Martínez Sierra and María de la O Lejárraga, his talented wife.


BENAVENTE

Famous abroad for his timely novel 'Los cuatro jinetes del Apocalipsis' (The Four Horsemen of the Apocalypse), Vicente Blasco Ibañez nevertheless attained but a low literary standard. Pío Barója poured out novels in a forceful, formless cataract, and Ramón Maria del Valle-Inclán was a powerful, startling stylist. Another stylist, leading critic of Spain, was José Martínez Ruiz, called Azorín, corrective of Spanish fluency and figures of speech. Salvador de Madariaga, made first ambassador to the United States by the new Spanish republic, showed equal skill as poet and novelist.

Greatest intellectual force in Spain in recent years was Miguel de Unamuno, philosopher, poet, and novelist, who, like Madariaga, spent years in exile previous to the downfall of Alfonso XIII. Like the Socialists, he resisted the confining ideas of race and nation, not because they impede the action of groups but because they limit the individual. Individualism was strong in his most famous work, 'The Tragic Sense of Life'. The conflict between faith and reason, the essence of Unamuno's work, is at the root of Spanish philosophy. (For Reference-Outline and Bibliography, *see* Language and Literature.)


IBAÑEZ

PROMINENT FIGURES IN SPANISH LITERATURE

'El Cantar de mío Cid' (Poem of the Cid), about 1140.
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Juan Ruiz (14th century), poet and prose fiction writer—'El Libro de buen amor'.
Gil Vicente (1470?–1536), dramatist—'Amadís de Gaula'; 'Ignez Pereira'.
Mateo Alemán (1547?–1614?), novelist—'Guzmán de Alfarache'.
Miguel de Cervantes Saavedra (1547–1616), novelist, dramatist—'Don Quixote', novel; 'La Numancia', play; 'Novelas exemplares', stories.
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Pedro Calderón de la Barca (1600–1681), dramatist—'La Dama duende'; 'El Alcalde de Zalamea'; 'El Mágico prodigioso'; 'La Vida es sueño'; 'La Cena del rey Baltasar'.
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Diego de Torres Villarroel (1696–1770?), autobiographer—'Vida'.
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Juan Valera (1824–1905), novelist—'Pepita Jiménez'.
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Pedro Antonio de Alarcón y Ariza (1833–1891), novelist—'El Sombrero de tres picos' (The Three-Cornered Hat).
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Pío Barója (1872–), novelist—'Camino de perfección'; 'La Busca'; 'Mala hierba'; 'Aurora roja'.

Vicente Blasco Ibañez (1867–1928), novelist—'Los cuatro jinetes del Apocalipsis' (The Four Horsemen of the Apocalypse); 'La Catedral'; 'Mare Nostrum'; 'Sangre y arena'.
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Juan Ramón Jiménez (1881-), poet—'Arias tristes'; 'Piedra y cielo'.
Gregorio Martínez Sierra (1881-) and his wife María de la O Lejárraga (1880-), poets, novelists, dramatists, under signature Martínez Sierra—'Flores de escarcha', verse; 'Tú eres la paz', novel; 'Canción de cuna', play.
Salvador de Madariaga (1886-), poet and novelist—'La Girafa sagrada', novel; 'Romances de Ciego', poem.

SPARROW. Sparrows are the plainly colored members of the finch family, but their musical ability makes up for their lack of fine feathers. The males and females look much alike. In North America there are about 40 species, found nearly everywhere.

The song sparrow, which makes its home near water, has heavily streaked underparts and a black spot centering its breast. One of the first signs of spring is the voice of this great singer. In the woodland lives the reddish-brown fox sparrow, also a master musician. As you walk along the road another sparrow darts from the weeds, and two white outer tail feathers mark him as the vesper sparrow. This six-inch bird of the plains and fields is famed for the appealing melody of its song. Other noted singers are the white-crowned and white-throated sparrows, whose names describe them.

The swamp sparrow is a bird of the marshes, where it mingles its simple lay with the music of the marsh wrens. The confiding chipping sparrow may place its neat hair-lined nest low in the bushes of your garden. In a high-pitched voice it trills *chippy, chippy, chippy* so fast you may mistake it for a fiddling cricket. The short-tailed grasshopper sparrow, about five and a half inches long, lives in open fields. It is so named because its weak insectlike song recalls the grasshopper's chirp.

The prolific house sparrow, a hardy street urchin imported from Europe in 1851, is a weaver finch, not a true sparrow. It is disliked because of its untidy ways and its tendency to drive away more desirable birds.

Sparrows are summer residents throughout the United States and Canada, but most of them winter in the Gulf states. Their stout, conical bills are well adapted for seed-eating, but they also feed on insects. (For pictures in color of the song sparrow and the house sparrow, *see* Birds; Egg.)

Sparrows belong to the family *Fringillidae*. The scientific name of the song sparrow is *Melospiza melodia;* of the white-crowned sparrow, *Zonotrichia leucophrys;* of the vesper sparrow, *Pooecetes gramineus;* of the chipping sparrow, *Spizella passerina;* of the tree sparrow, *Spizella arborea*. The house sparrow (*Passer domesticus domesticus*) belongs to the family *Ploceidae*.

THE TREE SPARROW

A wedge of black spots its unstreaked breast; a rufous patch caps its head—by these marks you know the tree sparrow. In October it and its family leave Canada to spend the winter harvesting the season's crop of weed seeds in the northern United States.

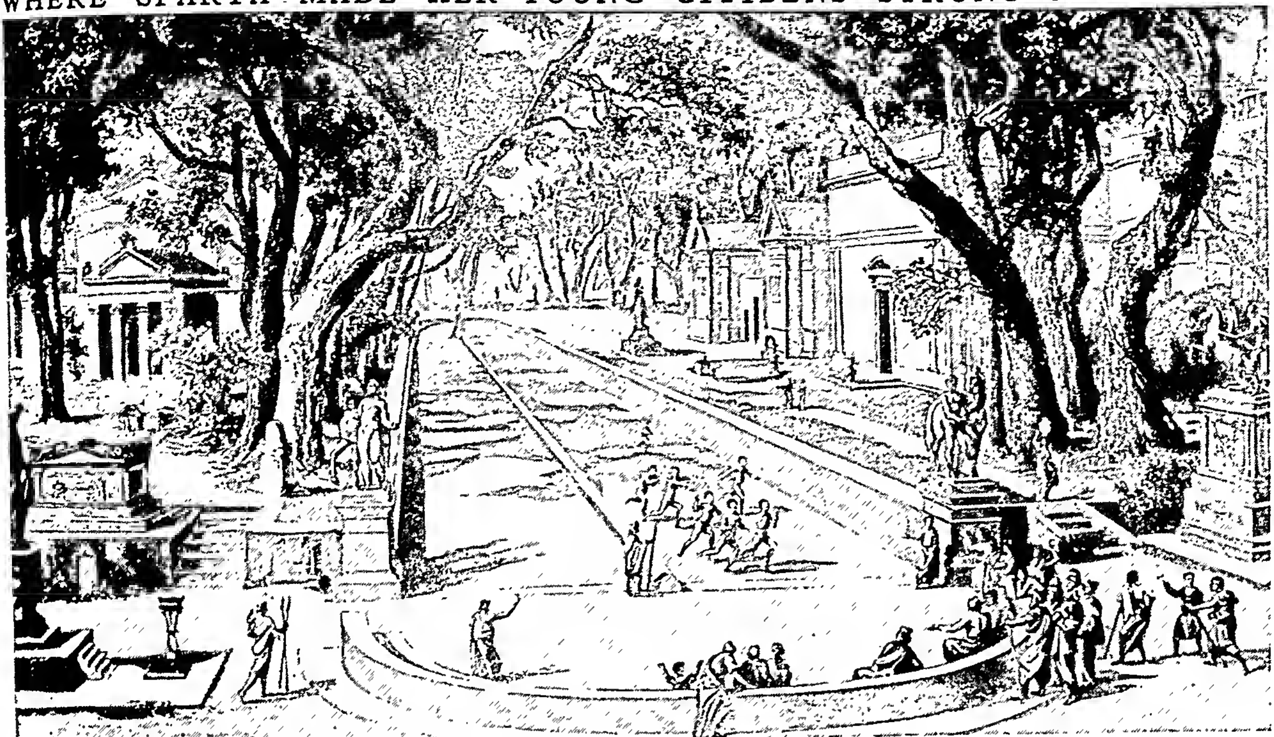
SPARTA, GREECE. The great rival of Athens in ancient Greece was Sparta, whose vigorous race of iron-hearted warriors has given us the adjective "spartan." Sparta prided itself not on art or learning or splendid buildings, but on its valiant men who "served their city in the place of walls of bricks." Although Athens, with its beautiful temples and statues, its poetry and philosophy, dominated the intellectual life of the world, it was Sparta which in the end wrested from its cultured opponent political supremacy.

The Spartan government was founded on the principle that the life of every individual from the moment of birth belonged absolutely to the state. The elders of the city inspected the newborn infants and ordered the weak and unhealthy ones to be carried to a nearby chasm and left to die. By this practice Sparta made sure that only those who were physically fit should survive.

The Hard Spartan Life

The children who were allowed to live were brought up under an iron rule. At the age of seven the boys were removed from the control of their parents and organized into small bands. The strongest and most courageous of the boys were made captains. They slept in public dormitories upon hard beds of rushes; they ate together of black broth and other coarse and meager fare; and they wore only the simplest and scantiest clothing. Unlike the boys of Athens, they spent little time learning music and literature. Instead, they were drilled each day in gymnastic and military exercises until their muscles were like iron and their will power like steel. They were taught that retreat in battle or surrender was a disgrace. They were taught to endure

WHERE SPARTA MADE HER YOUNG CITIZENS STRONG AND HARDY



Here are some Spartan youths receiving a most important part of their education. The temples and statues of the gods, and especially of the Great Twin Brethren Castor and Pollux—Spartans and athletes as well as gods—looked over it, for nothing, according to Spartan view, was more worthy of divine approval than the training of brave and hardy citizens.

pain and hardship without complaint, and to obey orders absolutely and without question.

They were allowed to feel the pinch of hunger and encouraged to supplement their fare by pilfering food for themselves. This was not done to cultivate dishonesty, but to develop shrewdness and enterprise. If they were caught, they were whipped for their awkwardness. Once, it is said, a Spartan boy, having stolen a young fox for his dinner, allowed the animal, which was hidden under his cloak, to gnaw out his vitals rather than to betray his theft by crying out. The girls were educated in classes under a similar system, but with less rigor.

Discipline grew even more rigorous when the boys reached manhood. All Spartan citizens between the ages of 20 and 60 served in the army, and though allowed to marry, all had to belong to a men's dining club and eat and sleep in the public barracks. They were forbidden to possess gold and silver and their money consisted only of iron bars. War-songs were their only music, and their literary education was slight. No luxury was allowed even in the use of words. They spoke shortly and to the point, in the manner which we have come to call "laconic," from Laconia, the district of which Sparta was the capital (also called Lacedaemon).

The Three Classes in Sparta

There were three classes of inhabitants in Laconia. The Spartan citizens (*Spartiates*), who lived in the city itself and who alone had a voice in the government, devoted their entire time to military training. The *Perioeci*, or "dwellers-round," who lived in the surrounding villages, were free, but had no political rights. They were the tradesmen and mechanics—occupations not allowed to the Spartans. The *Helots* were serfs, little better than slaves, bound to the farms and forced to cultivate the soil for the citizens, their masters, who owned the land. These Helots whose marriages and children were not so strictly controlled by the state, were the most numerous class and bitterly hated their masters. Only the amazing organization and splendid fighting powers of the Spartan state could keep them under control.

Two Kings to Check Each Other

Another strange feature of Sparta was that the government was headed by two kings, who ruled jointly, serving as high priests, as well as leaders in war. Each king acted as a check on the other. There was a sort of cabinet composed of five *ephors* or overseers, who exercised a general guardianship over law and custom and came in later times to have greater power than the kings. The legislative power was vested in the assembly of Spartan citizens and in a senate or council of elders, chosen from the men who had passed the age of 60.

The Spartan armies, although usually quite small, were all but irresistible. Each citizen soldier was inspired by the resolve to win or die. The Spartan mother, when she gave her son his shield, used to say: "Bring back this shield yourself or be brought back upon it," referring to the manner in which the dead were carried from the battlefield.

The Spartan constitution is said to have been founded by Lycurgus (*see* Lycurgus). Under the

rigid discipline of its laws, Sparta extended its conquests over the neighboring states until it gained control of most of the Peloponnesus—the peninsula forming the southern half of Greece.

Sparta's prowess naturally brought rivalry with Athens, the leader of the northern states and for a time of all Greece. This rivalry culminated in the Peloponnesian War (431–404 B.C.), which resulted in Athens' ruin and Sparta's supremacy. But the tyranny of the Spartans aroused hatred and rebellion, and the jealous limitations on citizenship gradually cut down the number of the specially trained warriors until only a few hundred remained. After about 30 years of Spartan domination, the Thebans under Epaminondas defeated Sparta and ended its power. With the rest of Greece, Sparta was soon conquered by the Macedonians and finally became a part of the Roman Empire. (*See* Greece.)

The modern town of Sparta, built after the Greek War of Independence in 1834, occupies part of the ancient site, near the river Iri (the ancient Eurotas) and about 15 miles from the Gulf of Messenia. Population (1951 census), 7,900.

SPARTACUS (died 71 B.C.). For many years the name of the Thracian slave Spartacus was terrible to the ears of the old Romans; for it reminded them of the danger that constantly menaced the very existence of their state, the danger of an uprising of the enormous slave population that might wipe out the Roman nation at a blow. Scholars have calculated that for every freeman in ancient Italy there were three slaves. If these unhappy men, goaded by the brutal treatment they received as household and plantation laborers, had once united under capable leadership, nothing could have withstood them.

There were many slave uprisings in the history of Rome, but the most formidable was that headed by Spartacus in 73 B.C. Escaping from the school of gladiators at Capua, he fled to Mount Vesuvius, where he collected an army of runaway slaves like himself. For two years he terrorized Italy, defeating army after army sent against him from Rome, and laying the land waste from the foot of the Alps to the southern tip of the peninsula. But the insurrection was finally crushed, Spartacus was slain, and 6,000 of his followers were crucified along the Appian Way leading to Rome.

School children long ago used to recite Elijah Kellogg's imaginary address, "Spartacus to the Gladiators at Capua." Its stirring lines concluded with: "If ye are men—follow me! . . . if we must fight, let us fight for ourselves! If we must slaughter, let us slaughter our oppressors! If we must die, let it be under the clear sky, by the bright waters, in noble, honorable battle!"

At the close of the first World War, the name "Spartacans" was applied to the extreme radical wing of the German Socialists. The leader of this faction, Karl Liebknecht, had written under the pen name of "Spartacus" while he was being held a prisoner by the German government. The origin of the group is found in the opposition of the extreme left to the war. It led to a split in the Socialist party and the formation of the Independent party—the Spartacans. After the revolution of 1918 and the overthrow of the Kaiser, the party became even more radical.

SPECTACLES. Normal vision is called "20-20." This means that from a distance of 20 feet, an eye can see what it should at that distance. However, if an eye is abnormal in shape or action, the abnormality may cause a defect in vision.

Many defects can be overcome by wearing a combination of lenses and supports called spectacles. The lenses are ground to counteract the defect, as determined by tests. Some tests consist of reading different-sized letters and describing various pictures and combinations of lines. The eyeball can be tested for shape with instruments. An examiner also looks at the retina for symptoms of disease. These tests show not only how great the defect of vision may be, but the cause of the trouble. The shape of the eyeball may cause nearsightedness or farsightedness. In many cases the muscles which control the eyes are out of balance with each other.

Considerable training and experience are required for this work, so it pays to have the eyes examined by a specialist. The wrong glasses may in time ruin the sight. There are two kinds of specialists. Doctors who can treat eye diseases as well as correct vision defects are called *oculists* or *ophthalmologists.* Men who are trained to correct defects of vision only, and are limited by law to this field of work, are called *optometrists.*

After an examiner prescribes glasses, they are made by an *optician.* He grinds blanks made of special optical glass into lenses having the prescribed curves. Concave lenses are used to correct short sight, convex lenses for far sight; prisms, where the eyes turn in or out too much; segments of cylinders, for astigmatism or irregular curvature of the cornea, or crystalline lens; and endless combinations and modifications of these forms for complicated conditions.

Then the optician fits the ground and polished lenses into frames, adjusting each lens so that its center will come at exactly the right point in front of the pupil and tilting it to give just the right angle for reading or distant vision. Glasses with side bars or bows to pass over the ears are specifically designated spectacles, while those which clip to the nose are called eyeglasses or pince-nez. Single eyeglasses or "monocles" and glasses mounted on a handle (lorgnettes) are also used. Plain colored glasses are used to protect the eyes from glare and dust.

Spectacles were invented late in the 13th century, perhaps by Roger Bacon (*see* Bacon, Roger). They were crude at first and were little improved for centuries. Bifocal lenses were invented by Benjamin Franklin. These have a small lens for near vision set into a larger lens for distant vision. The latest development is the manufacture of *contact lenses.* They are made of glass or plastic and fit directly over the eyeball under the lids so as to be virtually invisible.

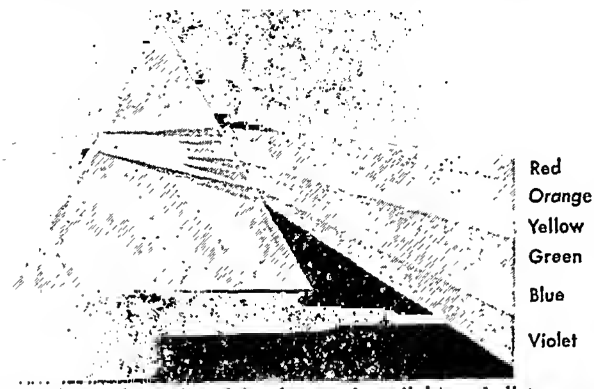
WHAT *the* SPECTRUM TELLS *the* SCIENTIST

SPECTRUM AND SPECTROSCOPE. From earliest times the rainbow had delighted and puzzled observers. Men invented myths to explain the beautiful arc of multicolored light that appeared after the rain. But a scientific answer to the puzzle of the rainbow did not come until 1666.

In that year Sir Isaac Newton began investigating the problem of eliminating the color fringes in telescope lenses. (Scientists now call these color fringes *chromatic aberration.*) He decided that the trouble might lie in the character of light itself. So he began to study how light formed colors, using glass prisms to analyze sunlight.

He admitted a small beam of sunlight into a darkened room and passed it through a prism. The beam produced a band of colors just like the rainbow, ranging from red through yellow, green, and blue to violet. He then passed each of these colors through other prisms and found that they did not change. But when he passed the whole band of colored lights through a prism in reverse position, the colored band became white sunlight again.

THE RAINBOW IN A SUNLIGHT BEAM



Here a prism *refracts* (bends) a beam of sunlight and *disperses* (separates) the white light into the colors of the solar spectrum. For diagrammatic purposes the colors are shown here as distinct bands. Actually the edges of the bands blend to form the same soft array of colors we see in a rainbow.

From this he reasoned that white light is really a mixture of colored lights, and that each color is bent by a different amount when it passes through the prism. This difference in bending enables each color to stand out separately and be visible (*see* Color). The band of colored lights thus formed is called a *spectrum.* The rainbow is actually a spectrum, formed by the sunlight passing through raindrops which act together as a giant prism (*see* Rainbow).

Dispersion and the Spectroscope

Separating light into its colors is called *dispersion.* It is accomplished by *refraction* (bending) of light in the prism. As explained in the article on Light, each of the colors has its own wave length. The wave length determines how much each color will bend as it passes through the prism. Red bends the least, violet the most. If the light beam strikes the prism at a certain angle, the amount of bending for each color is always the same. Each color then falls in exactly the same place on a screen, so its position is enough to identify it.

Scientists use the dispersive action of the prism in the *spectroscope.* The spectroscope reveals that the spectral pattern of light is different for various classes of light sources. Light from the sun, from certain lamp filaments, and from molten metals each produces a spectrum which has all colors in an unbroken array. Such a pattern is called a *continuous* spectrum. Incandescent gases, however, give off only certain colors. Their spectra consist of fine colored lines and are called *bright-line* spectra. Both bright-line and continuous spectra are *emission* spectra, because they are produced by emitted light.

Discovering New Spectrum Facts

In the early 1800's Joseph von Fraunhofer observed that the continuous spectrum was crossed by many dark lines. He charted more than 700 of them, but he was unable to explain their meaning. Because of his discovery, however, they are called *Fraunhofer lines.*

The meaning of the Fraunhofer lines was discovered about 50 years later by Gustav Kirchoff and Robert Bunsen. With a spectroscope they studied the spectra of certain substances which were vaporized in the nonluminous Bunsen burner flame. Each vapor showed a characteristic bright-line spectrum. But when emitted light was passed through a cooler vapor of the same substance, the bright lines were replaced by dark ones in the same position.

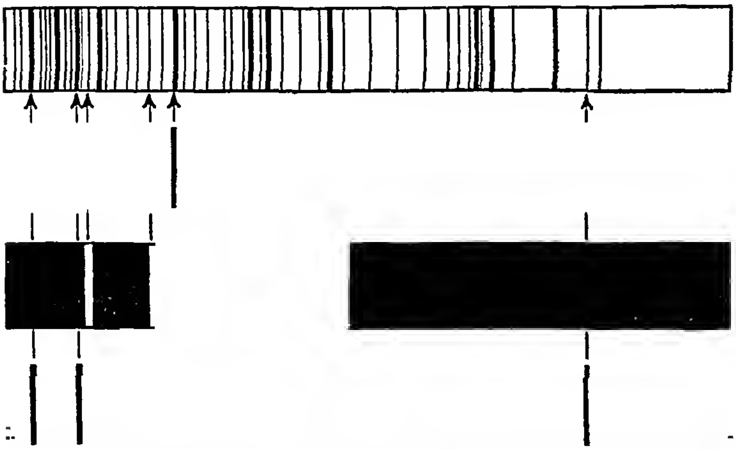
This replacement of bright by dark lines meant that the second vapor had absorbed the characteristic light of the first. Later experiments showed that the cooler vapor absorbs those light waves which it would normally emit at a higher temperature. In 1859 Kirchoff published his findings in his laws of radiation and absorption. The spectral pattern thus formed is called a *dark-line,* or *absorption,* spectrum.

Kirchoff and Bunsen also noticed that characteristic arrays of lines are given off by the different chemical elements. For example, incandescent sodium always gives certain yellow lines near the middle of the spectrum, and *no other element* gives these lines. Thus when these lines appear, sodium must be present in the incandescent substance. If the lines are bright the light has come directly from the incandescent sodium. If they are dark the light has passed, somewhere along its path, through an absorbing vapor containing some gaseous sodium. Other elements have similar lines; and these enable experimenters to identify the elements in an unknown substance. Only minute quantities of an element are needed to make its lines appear.

Analyzing the Sun

These discoveries not only explained the Fraunhofer lines in the spectrum of sunlight but made it possible to determine what chemical elements the sun contains. The absorption necessary to produce the dark lines was considered as taking place in the outer layers of incandescent gas surrounding the sun. For

HOW THE SPECTROSCOPE IDENTIFIES ELEMENTS



At the top is the "dark line" spectrum of sunlight, and the other illustrations show how the presence of certain chemical elements in the sun is made known. Each element gives a characteristic assortment of bright lines, such as shown (top to bottom) for sodium, lithium, and potassium. When lines corresponding to those in these spectra are present in the spectrum given by a sun or star, we know that these elements are present in it.

"analysis" of the sun, the dark lines could be compared with the bright-line spectra of different elements produced in the laboratory. Whenever they corresponded, scientists could be sure that the element existed in the sun. Stars likewise could be "analyzed" as to chemical contents by this method.

In order to carry out this work thoroughly, scientists have obtained spectra corresponding to the different elements, and have measured and charted every line. When they wish to learn the composition of a star, they photograph its spectrum, and then check the lines against these charts for the elements. A notable triumph of the method was the discovery of helium. In 1868, P. J. C. Janssen (1824–1907), a French astronomer, and the English astronomer, Sir Norman Lockyer (1836–1920), independently discovered lines in the solar spectrum which could not be identified with the charted lines of any known element. Lockyer interpreted this to mean that an element unknown to us existed in the sun, and named it helium, after *helios*, the Greek word for sun. Then in 1895 Sir William Ramsay (1852–1916) found that the Norwegian mineral *cleveite*, when heated, gave off minute quantities of a light gas which he identified as helium by means of its spectrum. (*See* Helium.)

Measuring Light Waves in Angstrom Units

Wave lengths are measured in various units, but the one commonly used in spectroscopic work is the Angstrom unit. This is one of the special units which science has accepted, as a means of avoiding the excessively long decimal fractions which would be needed to express wave lengths as short as those of light, if measured in inches or centimeters. The units commonly used are the *millimicron*, denoted by the symbol $\mu\mu$ and equaling one-millionth of a millimeter; and the Angstrom unit (A or A.U.), one ten-millionth of a millimeter. For example, violet light has a wave length of 410 millimicrons, or 4,100 Angstrom units. The following table gives the wave lengths which fall approximately in the center of each of the colored regions in visible light:

	$\mu\mu$	A.U.
Violet	410	4,100
Blue	470	4,700
Green	520	5,200
Yellow	570	5,700
Orange	620	6,200
Red	710	7,100

The huge numbers needed to express the frequencies corresponding to the various wave lengths of light (*see* Radiation) are simplified by writing 1,000 as 10^3, 1,000,000 as 10^6, and so on. Each higher value of the exponent, as the smaller numbers are called, means an additional zero added to the 10.

Since the color of light is determined by its wave length, this means that the shorter the wave length, the more the light is bent by passage through a given prism. Thus the wave length (and therefore the frequency) of the vibration causing the wave can be judged from the amount of bending given by the prism. This is determined by the position of the spectral line on the screen or photographic plate.

Prism and Diffraction-Grating Spectroscopes

A simple prism spectroscope has a collimator (tube for admitting light), a glass prism, and a telescope. The collimator has a slit at one end to admit light and a lens on the other to concentrate it. The lens directs the light on the prism, which disperses the ray into its component colors. Sometimes a train of prisms is used to increase the dispersion.

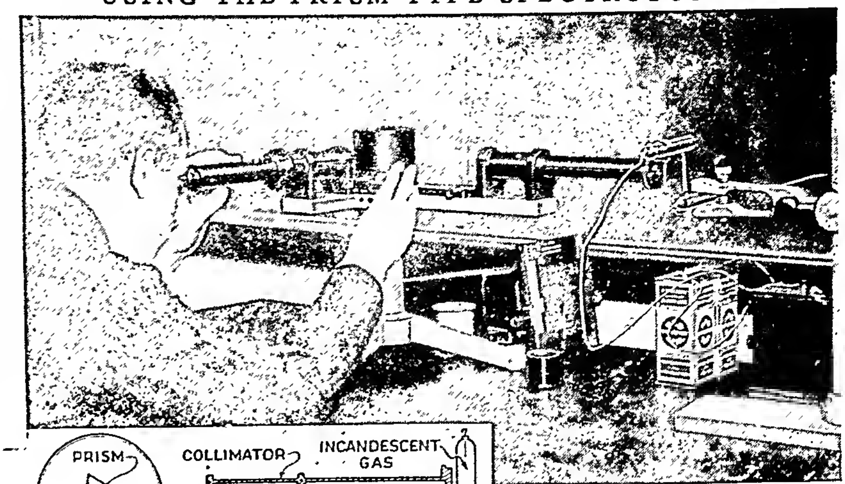
After the colors leave the prism they are focused on the object glass of the telescope. Each wave length appears as a separate image of the collimator slit. When the telescope is replaced by a camera to photograph the lines, the device is called a *spectrograph.*

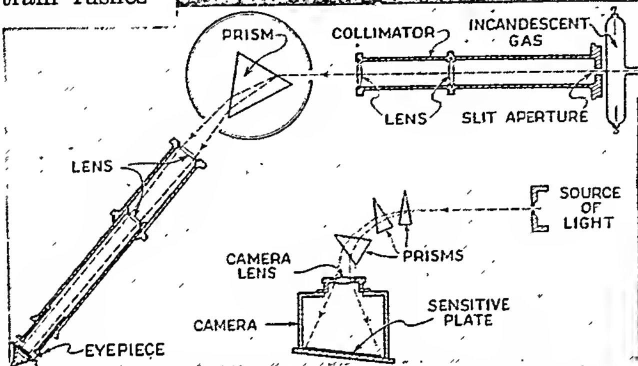
Diffraction and Echelon Spectroscopes

A more powerful type of spectroscope is one using a diffraction grating, invented by Fraunhofer in 1821. He made it by twisting a fine wire about two tiny screws. With it he measured the wave lengths of light with surprising precision. The modern precision grating consists of a plate of speculum metal or glass upon which fine lines, equidistant and parallel, have been ruled. Among the finest of these are the gratings made by H. A. Rowland, who invented a machine to rule the entire grating automatically, etching from 14,000 to 20,000 lines to the inch. By means of such a grating, made on a concave surface, Rowland secured a spectrum band of sunlight more than 20 feet long. The grating uses a special application of the interference phenomenon described in the article on Light.

Diffraction-grating spectroscopes are used in the laboratory where very precise measurements must be made. A diffraction grating measures the wave length of light with a precision of .000,000,000,001 cm. (10^{-12} cm.). It is used as the dispersing medium in

USING THE PRISM TYPE SPECTROSCOPE





Above is an observer using a "constant deviation" type of spectroscope, while the drawings below show the principles of construction used in the ordinary prism instrument, together with the way a camera can be substituted for the observer's telescope to form a spectrograph.

analyzing visible light and ultraviolet rays. A photographic plate is usually used as the detecting device.

Motion, Temperature, Magnetism

In addition to revealing the chemical constitution of stars, the spectroscope can also tell the astronomer whether a star is moving toward or away from the earth, by means of a phenomenon known as the *Doppler effect* (*see* Sound). Everyone has noticed how the whistle of an approaching locomotive rises to a shrill note as it approaches, then drops to a lower and lower tone as the train rushes away. This happens because when the train approaches, its whistle is nearer each time a sound wave is emitted, successive waves reach us a little more quickly, and therefore have a higher pitch. Similarly, when the train is receding the waves are dragged out and the pitch of the whistle is lowered.

Similarly, when a star is traveling toward the earth, each light wave is shortened a little, and consequently the lines shift their position toward the violet end of the star's spectrum. When the star is moving away from the earth, the wave-lengths are lengthened somewhat and the lines in the spectrum shift a little toward the red end. The amount of shift reveals the speed of the star's motion; but since light travels at the tremendous speed of 186,000 miles per second, the star must be traveling at a very great speed to create a noticeable effect.

Temperature and pressure have certain effects on spectra, and thus reveal the approximate temperature of stars, and even measure the pressure of gases on the sun and other distant bodies.

Another marvelous revelation of the spectroscope is the connection between magnetism and light. In 1896 the Dutch physicist, Pieter Zeeman discovered that when light passed through the field of a strong electromagnet, the lines in the resulting spectrum were split up into two or more lines. This influence of magnetism on light, named the *Zeeman effect* after its discoverer, has proved valuable in the detection and measurement of magnetism in the sun.

The Electromagnetic Spectrum

The colored lights in the rainbow make up but a small portion of that huge spectrum of energy called *electromagnetic radiation*. The other groups include infrared light (heat), ultraviolet rays, X-rays, and gamma rays. Despite the different effects they produce, each of these forms of energy travels through space as an electromagnetic disturbance. They are sometimes called forms of *radiant energy*. The article on Radiation tells more about these types of energy, their origin, their detection, and their measurement.

Spectra and the Nature of Matter

Study of the lines in various spectra has done much to help build the modern theory of matter (*see* Atoms; Electrons). Soon after Bunsen and Kirchhoff developed the use of spectral lines as a means of chemical analysis, men thought that the various lines were given off by atoms vibrating at different rates under the stimulus of heat, the faster vibrations giving the shorter waves that caused lines to appear toward the violet end of the spectrum. In 1885 Balmer found that the various rates of vibration in a mass of glowing hydrogen bore a simple mathematical relation to each other, indicating that some one type of "mechanism" was at work at varying rates, within the hydrogen atom, giving off the different wave-lengths; but he could not guess what this "mechanism" might be. J. R. Rydberg (1854–1919) extended knowledge of this subject, and developed a formula named for him which described many more observed relations; but he came no nearer than Balmer to learning what it was within the atom which vibrated. The answer to this problem came in 1913 from Niels Bohr of Copenhagen.

Bohr's theory, built to a considerable extent upon knowledge developed from the study of radioactivity (*see* Atoms; Radioactivity) held that the hydrogen atom consisted of an electron revolving like a planet around a central nucleus or "sun." Bohr believed further that as an atom absorbed energy, as by being heated, this orbit would enlarge by definite amounts, each enlargement representing the

absorption of one *quantum* of energy. When energy was emitted, as in the form of light, the electron would fall into inner orbits, by steps, and the frequency of the light would depend upon how many orbits were traversed. If the electron fell inward by one orbit, the "energy splash" resulting from this would travel outward as light of a certain frequency. If it fell inward two orbits, or if the electron in some other atom did this, light of a different frequency would go forth; and the collection of lines given by hydrogen in a spectroscope sums up these actions taking place in all the hydrogen atoms present. Furthermore, by using Planck's constant (the fundamental measurement of a quantum) and electrical factors in a formula of the Rydberg type, Bohr was able to reduce his whole explanation to terms of electrical force. Thus the spectrum of hydrogen stood explained as the product of electronic forces within the atom, and the spectroscope became useful for studying the structure of matter.

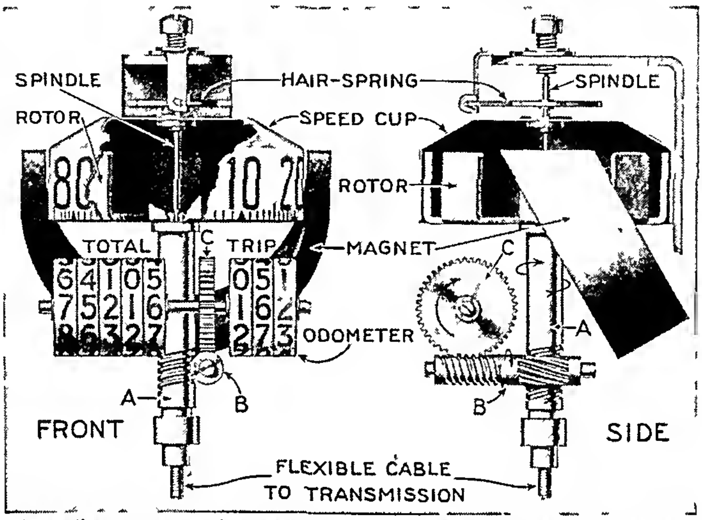
Obtaining Spectra with X-Rays

This type of work developed rapidly mostly because of the discoveries that X-rays could be made to give spectra just as light did. This was done by causing a beam of X-rays to fall slantwise upon the surface of a crystal. Since the space between the layers composing the crystal amounted to the "thickness" of only one or two atoms, this gave openings fine enough to diffract the short waves of the X-rays. Spectra, characteristic of the crystal used, resulted and could be photographed.

Within a year, an astonishing discovery followed. In 1913 and 1914, the young English physicist H. G. J. Moseley (1887–1915) announced the discovery of far-reaching relations among X-rays of various wave lengths, produced from the surface of different metals by the impact of electrons. Measured by methods similar to those used by Balmer for the visible spectrum of hydrogen, each metal, he found, gave certain groups of X-ray lines, corresponding to certain frequencies. As he passed from a lighter to a heavier metal, each successive element showed lines of higher frequencies. Moseley reasoned that this could not be due to increasing atomic weight, since several substances of varying atomic weights showed the same spectra. It must be due to a regular increase in planetary electrons, or *atomic number*, of the atoms of the metals. Moseley's work provided the modern periodic classification of elements (*see* Periodic Table).

SPEEDOMETER. A number of devices for indicating the speed at which vehicles travel have been produced. Perhaps the first of these devices was a speedometer that used a small fly-ball "governor" which was linked up to a pointer mechanism. Such instruments are still made, but the magnetic type is the most popular. Several other types have been used, but are now no longer manufactured in the United States.

THE CLEVER METER THAT MEASURES SPEED



These diagrams show the operating principle of a popular American speedometer. Gearing in the car's transmission drives a shaft A through a flexible cable. A rotor on the top of A turns inside an aluminum cup carried on delicate bearings at each end of the spindle. The poles of a magnet just clear the outside of the cup. As the rotor turns, it distorts the magnet's field and sets up eddy currents in the cup varying in strength as the speed of the rotor changes. The varying eddy currents thus drag the cup around to a greater or lesser degree as the car's speed varies, and the correct figure for the speed shows through the aperture on the dashboard, at the point where the front view has been cut away. The operation of the mileage register, an entirely separate mechanism, is explained in the text.

The type pictured here is a widely used form. The operation of the speed-indicating part is described in the legend below the picture. The mileage-registering portion, which is substantially the same in all speedometers, works on the following principle:

The shaft A is turned a definite number of times when the machine travels one mile or one kilometer. We are not concerned here with how *fast* it turns. That is taken care of by the ingenious speed-indicating mechanism. If, for example, shaft A turns 1,500 times per mile or kilometer, it can be geared down through the worm gearing on B and C so that the wheel C will turn one revolution per mile or per kilometer, if the metric system is used.

The "total" group at the left and the "trip" at the right are both operated from wheel C. By means of a peculiar intermittent movement (omitted for the sake of simplicity) each number wheel must make one *complete* turn in order to advance the wheel to its left $\frac{1}{10}$ of a turn. If C turns once per mile, the first wheel in the total group will then turn so that it indicates one more mile. It in turn passes on every complete turn to its nearest neighbor to the left, which turns $\frac{1}{10}$ turn, and so for all the group. The highest number is thus 99,999. One more turn of C will bring all the wheels back to zero. The trip indicator, which can be reset to any desired figure, contains a *tenths* wheel at the extreme right. The operation resembles that of the total group. Popular in Europe is a *chronometric* type, in which a clock mechanism controls a counting device, calibrated to show speeds.

SPELLING. A great deal has been said about the difficulties of English spelling—much of which is not true. Learning to spell, of course, like everything else worth while, requires effort. But it need not be a bugaboo. Everyone can learn to spell if he goes about it in the right way.

Many have said that English is not a phonetic language, that is, it is not spelled as it is pronounced. Let us look into this statement. Investigation shows that some 22 per cent of the words in common use are non-phonetic, but that leaves 78 per cent that are spelled as they sound and are pronounced as they look. An authority on word study calls attention to the fact that "six of every seven syllables of our language are phonetic." Such difficulties as there are, then, must lie in the 22 per cent non-phonetic words, and with the one syllable out of seven.

Now we might make a list of non-phonetic words (words that look one way and sound another), so that we would not have to waste our time on words that are easy to spell. But to make such a list is not so simple as it might appear. For in that list we want only the words that we actually *use*. Each of us has three vocabularies: one for reading, one for writing, and one for speaking. The first is decidedly the largest. We understand in our reading many more words than we use. It has been estimated that the average person can read and understand between 8,000 and 10,000 words. Our writing vocabulary is not more than half as large; from 4,000 to 5,000 words are enough for all the writing we are likely to do. Oddly enough, though most of us speak many hundreds of words for each one that we write, the actual number of different words we use in speech is small, not more than 700 on the average. It is said that the average talker makes only 43 words do duty for half his ordinary conversation, using these 43 words over and over again. They are: and, be, have, it, the, to, will, you, about, all, as, at, but, can, come, day, dear, for, get, go, hear, if, in, me, much, not, on, say, she, so, that, these, this, though, time, we, with, write, your, her, one, of, by. What a difference between the ordinary person and the scholar! Woodrow Wilson used, it has been found, 6,200 different words in 75 of his speeches, but at least 60,000 in his writings.

To compile a scientific spelling list we evidently need to separate our writing from our speaking vocabulary, or, in other words, to find out just what words we use in writing. Elaborate investigations have been made to discover what are the common words in the writing of school children and of adults. The results of these investigations appear in the Jones list, the Thorndike list, the Ayres scale, the Iowa scale, the Commonwealth list, and several more, giving us the "commonest words," grouped as the "first thousand," "second thousand," and so on up to 10,000. While no one of the several investigations has given us a list which we may regard as final, a composite list made up of the words that are common to a majority of these lists and scales may be accepted as a writing vocabulary approximating that used by the majority of people.

Some of the investigators have carried on tests to determine the relative spelling difficulty of the "commonest words," and have made groupings to indicate the school grades in which they should be learned. The following list of 100 is widely cited as the most difficult of those in ordinary use:

which	writing	ready	choose	very
their	heard	forty	tired	none
there	does	hour	grammar	week
separate	once	trouble	minute	often
don't	would	among	any	whole
meant	can't	busy	much	won't
business	sure	built	beginning	cough
many	loose	color	blue	piece
friend	lose	making	though	raise
some	Wednesday	dear	coming	ache
been	country	guess	early	read
since	February	says	instead	said
used	know	having	easy	hoarse
always	could	just	through	shoes
where	seems	doctor	every	tonight
women	Tuesday	whether	they	wrote
done	wear	believe	half	enough
hear	answer	knew	break	truly
here	two	laid	buy	sugar
write	too	tear	again	straight

An examination of these words shows that one-third of them are *homophones* (words that are sounded alike but spelled differently, such as, *there, their; two, too*). It is obvious that we cannot spell any homophonous word until we know which one of the pair or group it is; that is, we must know its meaning.

The other difficulties in English spelling are due chiefly to the confusion in the formative days of the language between the phonetic standards of Anglo-Saxon and Norman-French; in part to the retention of old spellings after pronunciations had changed; to the introduction of new spellings based on mistaken analogies and etymologies; and to the borrowing by English from every other language.

It is economy of time to learn the spelling, pronunciation, meaning, and use of a word all at the same time. One of the serious mistakes of schools in the past was that they required pupils to spell words which were altogether beyond their understanding. The practise of the modern school is different.

The first step in seeking to know a word is to *see* it exactly. Much, perhaps most, of misspelling is due to *half*-seeing words. The second step is to pronounce the word precisely as it should be pronounced. If you say the word correctly, you will not write *prespiration* for *perspiration*, nor *suprised* for *surprised.* You must form two images of the word—the visual (the *look* of it) and the auditory (the *sound* of it)—and these two images must be closely associated in your mind. Next, center your attention on the critical point in its spelling by asking yourself, "What is the particular thing to remember about the form of this word?" The only difficult point about the word *thumb* is the silent *b* at the end. Fix your mind on that, connecting it with such words as *climb*, *comb*,

lamb. You will never forget how to spell *separate* if you associate it with *parade*, which has the same Latin root. Then analyze the word: separate it into its parts; put together the meanings of these parts to see just what the word originally meant, or literally means; try to explain how the present or derived meaning comes from the original meaning. For example, take the word *conductor*. The dictionary shows that it comes from the Latin *con* (with or together) + *ducere* (to lead) + *or* (one who). A conductor, then, is one who leads or directs other people. A knowledge of the derivation of a word frequently helps us to remember a peculiar spelling, as *Wednesday*, from *Woden*. Finally, there is the meaning of the word. This includes definition and use, or uses, and a list of the various senses a given word may have. The word *stanch*, for example, is a transitive verb, an intransitive verb, a noun, and an adjective, and to know that word is to be able to use it in all four senses.

The best type of spelling book not only makes its selection of words by a comparative study of the lists and scales of the investigators but it *organizes* these words according to scientific pedagogical principles. Derivative forms are grouped so that pupils come to see the system by which they are built up. Homophones are presented first in illustrative phrases or short sentences. Words phonetically similar are brought together, so as to make use of the principle of association. By such means the number of separate facts that must be learned is reduced.

It is true that only a few rules for spelling English words are really helpful. But those few do help, particularly when the pupil arrives at them for himself *after* studying groups of illustrative words. The addition of the suffix *-ing* to *write, ache, guide, desire, bruise, increase, prepare*, etc., enables us to formulate the rule for dropping final silent *e* before suffixes beginning with a vowel.

By adding *-ed* or *-ing* to *compel, confer, refer, submit, acquit, control*, etc., we learn that monosyllables and words accented on the last syllable, ending in a single consonant preceded by a single vowel, double the final consonant before a suffix beginning with a vowel.

HERBERT SPENCER

Such words as *deny, comply, query, verify, dusty, muddy, homely, pretty, jolly*, and others ending in *y* preceded by a consonant change *y* to *i* before *-ed, -er, -est, -able*. Thus: *denied, complied, dustier, muddiest, prettiest, verifiable*. But note the forms *denying, complying, studying*.

Final *e* is dropped before an ending beginning with a vowel (as *seize, seizure; conceive, conceivable*), but retained before an ending beginning with a consonant (as *achievement, encouragement*). Exceptions: *judgment, abridgment, argument, lodgment, acknowledgment*. The *e* is also retained when needed to keep the identity of a word (as *dyeing, shoeing, hoeing*), or to keep the soft pronunciation of a *g* or *c* (as *peaceable* and *changeable*). (*G* and *c* before *a, o*, and *u* are pronounced as in *gave* and *cat;* before *e, i*, and *y* they are pronounced as in *gentle* and *cent*.) Most plurals are formed by adding *s* to the singular. But words ending in *s, x, z, ch, sh*, form the plural by adding *es*. Thus: *circuses, taxes, churches*. Singular forms ending in *y* preceded by a consonant form the plural by changing *y* to *i* and adding *es*. Thus: *salaries, factories, remedies, cherries, libraries*.

To avoid confusion between *ei* and *ie*, keep in mind the word *Alice*, in which you have *li* and *ce* to remind you that *i* follows *l* and *e* follows *c*. This will help with words like *believe, relieve, receive, perceive*, etc., but it applies only when the sound is long *e*. Otherwise *ei* is the more usual spelling, as in *deign, vein, rein, freight, height, sleight, foreign, counterfeit, heifer*. The old jingle is "Use *i* before *e* except after *c*, or when it's like *a* as in neighbor or weigh." But remember the exceptions: *financier, seize, weird, either, neither, leisure, inveigle*.

If you are confused about whether to end a word in *-able* or *-ible*, try to think whether there is a noun related to it ending in *-ation*. If a word has a noun ending in *-ation*, the adjective generally also has *a* in its suffix and ends in *-able*. Thus *accuse* has the noun *accusation* and the adjective *accusable;* and we have *limitation, limitable; duration, durable, detestation, detestable*, etc. If there is no noun ending in *-ation*, the adjectives usually end in *-ible*, as *collectible, digestible, repressible*, etc.

There have been many attempts to introduce simplified spellings. The first was that of Noah Webster, who, in his 'American Dictionary' (published in 1828) dropped the *u* from such words as *favour, honour, mould, colour*, and changed the French-derived *metre, centre, theatre*, etc., to *meter, center, theater*. These simpler spellings have largely taken the place of the others in America, but the English still use the old forms. Twelve spellings adopted by the National Education Association are recognized by the newer dictionaries and are in general use; these are: *program, catalog, decalog, prolog, pedagog, tho, altho, thoro, thoroly, thorofare, thru*, and *thruout*.

SPENCER, HERBERT (1820–1903). Although he had spent only three years in school, Herbert Spencer surveyed all human knowledge in his books on philosophy. By so doing, he gave the world a notable example of the 19th-century belief that in time science would explain everything.

Spencer was born in Derby, England. His father was a schoolteacher who believed that young Herbert could learn best by observing natural objects and by

reading and thinking about them. He did not send Herbert to school until the boy was 13 years old. After that Herbert spent almost ten years doing engineering work and trying his hand on inventions.

When he was 28, Spencer became sub-editor of the *Economist* and began writing essays for the *Westminster Review*. The essays included statements of his unfolding philosophic beliefs. They attracted favorable attention from several scientists whose friendship broadened Spencer's views.

In 1850 his 'Social Statics' was published. In this book Spencer insists that government must not interfere with individual rights. When an uncle died in 1853 and left Spencer £500, he gave up editing and became a free lance writer. Within two years he published 'Principles of Psychology.' Spencer was always frail, and by now he had ruined his health. He became nervous and was unable to sleep well the rest of his life.

During these early years of preparation and experiment, Spencer was working toward a theory of evolution, unaware of the research being done along this line by Charles Darwin. He came to feel that mental and physical development are controlled by universal laws. He saw evolution changing life and matter from simple to complex forms, and dissolution breaking things down to simpler forms.

In 1860 Spencer announced that he would prepare a set of ten books wherein he would apply his theory of evolution to biology, psychology, sociology, ethics, and other fields. He called this last great work the 'System of Synthetic Philosophy'. He allotted himself 20 years for this monumental task, but he spent 36 years completing it. It summed up the scientific thought of the latter 19th century and assured Spencer a unique place among philosophers.

SPENGLER, OSWALD (1880–1936). A gloomy book published at the end of the first World War had a tremendous effect on people in many countries. This was the German philosopher Spengler's great study 'The Decline of the West'. In this work, Spengler argued that civilizations rise and fall in regular patterns. He thought that Western civilization had already started its period of decline. He added that it was doomed to be replaced by a young and vigorous Asiatic civilization.

Spengler was born in Blankenburg-in-the-Harz. He attended the universities of Munich and Berlin, studying mathematics, philosophy, history, and art. Later he taught mathematics and followed his interests in statistics. The influence of this training shows in his books, for he drew most of his arguments from these fields.

During the first World War he was living in poverty in Munich and could not afford to buy books or even fuel for his cold attic room. But he threw all his energy into writing 'The Decline of the West'. At first he could not find a publisher willing to accept the book, but finally he managed to get it published in Vienna in 1918. Three years later he withdrew it and republished a revised edition in 1923. This version was translated into the languages of most of the civilized countries of the world. It made his reputation immediately.

The success of his book made Spengler a wealthy man and he lived the rest of his life in ease. At first he was in favor with the Nazis and his theories affected the official Nazi philosophy. But he would not approve anti-Semitism and he lost favor.

SPENSER, EDMUND (1552?–1599). Virtuous knights, evil giants, beautiful ladies, and loathsome ogres walk through the fairyland of Spenser's great epic 'The Faerie Queene'. The poem is a long allegory of the struggle between good and evil. Spenser had originally planned it in twelve books, each book to depict a particular "moral virtue" in a knight. By the time of his death, however, he had completed only six.

The story has three levels of plot or meaning, which run along together. On the surface, the narrative is a courtly romance. We can read the story with enjoyment on this level alone. But to understand Spenser's purpose we must unravel the meaning behind the characters and their actions, as told by the other two levels.

On the second level, one character represents an ideal Christian, another Truth, still others the seven deadly sins of the medieval church, and so on. Here the plan of the story is something like John Bunyan's 'Pilgrim's Progress'.

On the third level, the characters stand for real persons of Spenser's day and earlier. This level gives modern readers most trouble, for few of us are very familiar with all these people. And the poet shifts back and forth between these levels. Sometimes, for instance, the evil Duessa represents Falsehood, and sometimes she represents Mary, Queen of Scots, the cousin and enemy of Queen Elizabeth I.

Spenser invented the stanza form he used in 'The Faerie Queene'. This "Spenserian stanza" has nine lines. Eight are ten-syllable lines, rhyming ABAB BCBC; a ninth line, containing twelve syllables and rhyming in C, closes the stanza.

Spenser was born in London to a poor family, probably in 1552. He attended the Merchant Taylors' School where his expenses were partly paid out of charity funds. Entering Cambridge University in 1569, he took the Bachelor's Degree in 1573 and the Master's Degree in 1576. He must have written poetry from an early age, for he contributed some well-constructed sonnets to a collection published in 1569.

Sometime after leaving the university, he took a position in the household of the Earl of Leicester. There he met his fellow poet Philip Sidney and they became close friends. In 1586 Spenser commemorated Sidney's tragic death in the moving elegy 'Astrophel'.

In 1580 he became secretary to Lord Grey, the Lord Deputy of Ireland. Spenser went to Ireland with him and later acquired Kilcolman Castle in Munster for his use. The beautiful scenery of this district appears again and again in his poetry. Sir Walter

Raleigh visited him there in 1589 and persuaded him to publish the first three books of 'The Faerie Queene'. This he did, and the poem was immediately popular. Spenser married Elizabeth Boyle in 1594 and wrote the beautiful 'Epithalamion' to celebrate his wedding. The following year he published the second three books of his great epic.

Spenser was appointed sheriff of Cork in 1598, but his castle was burned by rebels in an uprising. Sick in spirit and body, he returned to London and died shortly after his arrival.

Spenser's other poetry is now probably read more widely than his masterpiece. 'The Shepheards Calender' is a series of twelve pastoral poems, one for each month of the year. 'Colyn Clouts Come Home Againe' is a delightful poem celebrating his return home after a visit to London. In it Colyn Clout, a shepherd, tells his fellow shepherds in Arcady about a visit to the court of Cynthia (Queen Elizabeth I) and the wonderful things he saw there. The 'Amoretti' is a sonnet sequence addressed to the young woman whom he married.

SPHINX. Chiseled from solid rock nearly 3,000 years before the birth of Christ, the Great Sphinx of Egypt, like a gigantic sentinel, still guards the cemetery of Gizeh at the entrance of the Nile Valley. It has the body and paws of a lion, but its head is a portrait statue of King Khafre, who built it and placed it before his pyramid tomb. "Wise as the sphinx" we sometimes say, and no wonder; for what secrets might not those lips of stone reveal could they but speak! For nearly 5,000 years it has crouched on the desert sands, gazing unmoved toward the east. Before its eyes generations, centuries, eras of history have unfolded; empires have grown up in splendid power and have passed away in slow decay; the tide of civilization has swept forward, new religions have encircled the earth, new continents have been discovered, the world has been made over—yet the sphinx still stands patient and motionless.

Only one thing has changed the expression of that massive countenance. Grains of sand caught up by the hot swirling winds of the desert have kept up their tiny bombardment through the ages. Bit by bit they have scratched and chipped and rasped the solid rock until all the sharpness of angles and lines has melted away. The beard is gone; the nose is no more; the "graceful smile" described by the visitors of old has vanished, leaving the strange inscrutable look which led the Arabs to call it the "Father of Terrors." Perhaps some desert vandals, enraged at the "pagan image," have helped mar the surface of the figure, but the great mass of the body remains in crumbling outline defying time and man.

As we approach the sphinx where it looms between the river and the sands, we might mistake it for one of the many fantastic dull red and amber-colored rocks of the valley. At closer range this half-human,

THOSE PAWS WERE HIDDEN FOR 4,000 YEARS!

After being buried up to the neck in sand for centuries, the Sphinx was revealed in its entirety when an army of workmen cleared the sand away in 1926. Previously the neck had been repaired with concrete, where the sand had worn away great portions of the rock.

half-animal colossus becomes evident for what it is and we ponder on "the mighty Pharaohs, and Hebrew law-givers, and Persian princes, and Greek philosophers, and Antony with Cleopatra by his side, and Christian anchorites, and Arab warriors, and European men of science, all brought hither in succession by the unpausing ages to look into those eyes—so full of meaning though so fixed!"

The head of the sphinx measures 19 feet from top of forehead to bottom of chin and 91 feet in circumference at the broadest part, with the shoulders and the upper portion of the paws extending forward 56 feet. The mammoth body is 172 feet in length, while the height from the ground to the top of the head is 66 feet.

These dimensions were discovered in 1926 when the Egyptian government succeeded in digging away the surrounding sand, revealing the complete body of sculptured rock and the paws of built-up stone. Egypt has many smaller sphinxes, usually in pairs at the approach or entrance to a temple.

From the Egyptians the Greeks borrowed their idea of a sphinx, which they conceived as a monster with the head of a woman, the body and paws of a lion, and huge bird-like wings. According to the story, this monster put a riddle to all those who passed by, and devoured all who failed to guess it. After many had died in this way, the Theban hero Oedipus succeeded in solving the riddle and so caused the monster's death. (*See* Oedipus.)

The WORLD-WIDE *Search for* SPICES

How Pepper, Cloves, and Their Many Sharp-Flavored Cousins Have Made History, Inciting Discovery, Creating Commerce, Provoking Wars—The Precious Products of Tropical Climates and How They are Obtained

SPICES AND CONDIMENTS. If modern cold storage had been known in the days of Columbus, the New World might not have been discovered until centuries later. For without our modern means of keeping food palatable throughout the year, the Europe of the Middle Ages and later times found spices almost indispensable to flavor its poor and often half-spoiled food. In medieval England, for example, the usual winter diet consisted of meal and coarse salt meat, which became half-rotten by spring. So spices were in enormous demand to lend some savor to this monotonous and pleasureless fare. Cinnamon, cloves, and pepper were worth their weight in gold; and men risked their lives and fortunes in seeking new routes to the lands of spices—the East Indies and the neighboring parts of Asia.

For centuries these condiments, so common with us that we scarcely give them a thought, were among the most important articles of commerce. The spice trade was a leading factor in determining the rise and fall of states, in provoking wars, and in discovery and exploration. It was chiefly the desire to find new ways of access to this vastly profitable trade that led to the discovery of sea routes to the east and the discovery of America. Arabia was at first the great distributing center for spices, which were brought overland in great caravans. Venice rose to world power through her control of the Mediterranean trade in spices and other imports from the East. When Venice lost command of the trade through the discovery of new sea routes to the East, first Portugal, then Holland, rose to wealth and power largely through the spice monopoly.

In the days of Queen Elizabeth the Dutch went so far in their efforts to keep all the spice trade in their own hands that they cut down clove, cinnamon, and pepper trees in districts not directly under their control and inflicted the severest punishments on anyone who attempted to infringe on their monopoly. In Ceylon, the great cinnamon center, death was the penalty for the illegal sale of even a single stick of cinnamon; and this law remained in force until the English took the island in 1796. It was largely to break the grip of the Dutch on the profitable spice trade that the East India Company was formed in England, thus laying the foundations for British rule in India.

Many of our spices still come from the East Indies and the neighboring lands. Pepper, cardamom, and cinnamon are native to India and Ceylon; nutmeg and mace, cloves, clove-bark, turmeric, and ginger come from the Malay Archipelago; cassia bark from China. Africa gives us grains of paradise, the pungent seeds of a plant used largely in early days as a substitute for pepper, while the American tropics have supplied vanilla, red peppers, and the clove-like pimento or allspice. The colder climates of northern Europe and Asia have produced but few—coriander, cumin, caraway seed, parsley, mustard, and calamus root.

Many of these aromatic substances have other uses besides that of flavoring agents. Some are valuable in perfumery, confections, and scented soaps, as vanilla, cloves, and pepper, or in the manufacture of incense, as cinnamon. Many are utilized in medicine, as cardamom, ginger, nutmegs, oil of cloves, etc. Turmeric is used in dyeing, especially by the natives of India and China, and marjoram serves in dyeing wool. Other spices are used in various arts.

It is a remarkable fact that a large proportion of the spices are successfully grown only on islands, or near the sea. Nutmegs, cloves, vanilla, cinnamon, and cardamom may be termed island plants, and long before the "spice islands" are in sight, sailors know they are in the vicinity by the heavy fragrance borne to them by the land breeze.

The flavor of spices is due to the presence of aromatic oils secreted in the plant, but these oils are richest in different parts of the various plants. In cloves and capers, it is the flower buds which are particularly aromatic; in coriander, capsicums, and pepper, it is the fruit. The ginger, licorice, and turmeric of commerce are roots or underground stems, and cinnamon and cassia are the inner bark of a tree. In most of the savory herbs—sage, mint, thyme, marjoram, etc.—the leaves are richest in these essential oils, while nutmegs, caraway, and anise are seeds.

When the flower buds are utilized they are plucked just before they are ready to break into blossom. The whole clove, as we get it in the shops, is the dried flower bud of a small bushy tree. The four petals are closed into a tight ball, held by four fleshy sepals. One of the early uses of cloves is recorded in an ancient Chinese court order, wherein the officers of the court are required to hold cloves in their mouths while addressing the sovereign. Capers, which are used as a seasoning for sauces, etc., are the salted and pickled buds of a bushy plant which grows wild on the mountainous slopes bordering the Mediterranean Sea. The flower is "sensitive," opening when the sun strikes it, and closing again as the sun sets, so the flowers must be gathered very early in the morning, between daybreak and sunrise.

Cinnamon is the dried inner bark of several species of trees. This aromatic bark has long been popular, having been highly prized in biblical times. Resembling it in flavor is its close relative, cassia bark. Cassia buds, the dried unripe fruit of the cassia tree, are also used.

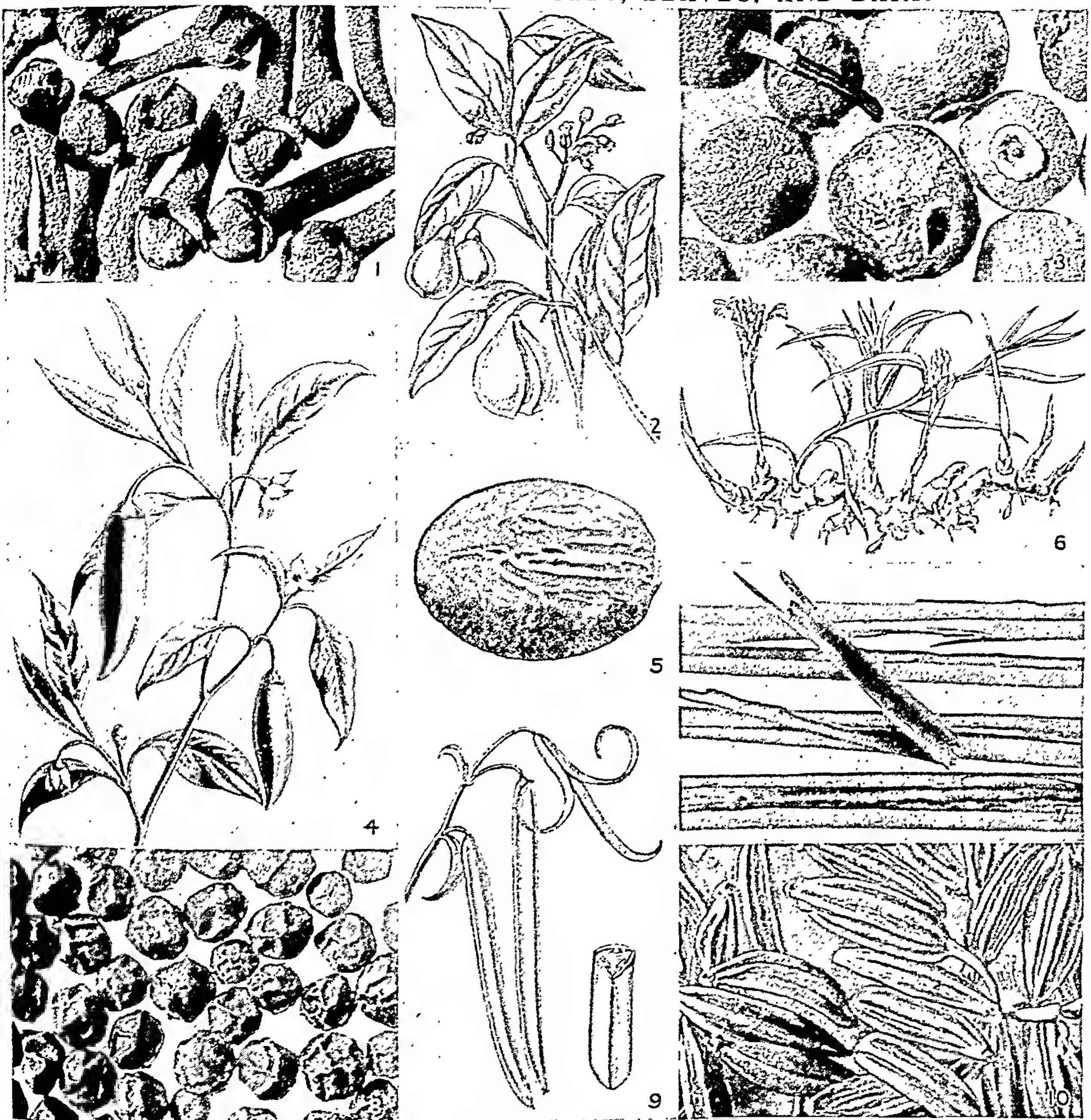
Pimento or allspice—not to be confused with the pimiento (*see* Pepper)—consists of the little unripe fruits of a tree which resembles the clove The spice takes its popular name from its resemblance in perfume and taste to a mixture of cinnamon, cloves, and nutmeg, and with them forms the four spices to be found in every kitchen. The fruit is about the size of a black currant and resembles peppercorn. The word pimento is taken from the Spanish word *pimienta*, meaning "pepper."

Coriander is one of the oldest spices, being mentioned in early Sanskrit and Egyptian writings. It is the fruit of a small herb growing on the shores of the Mediterranean, and is largely cultivated in India. It is valued as an ingredient in confectionery, to disguise unpleasant tastes in medicines, and as an ingre-

DRYING CLOVES IN A "GARDEN OF SPICES"

The flower buds of the clove tree, gathered by hand, are spread out on mats to dry in the sun, being sometimes previously dried by exposure to the smoke of wood fires. When first gathered they are reddish, but drying turns them a deep brown.

FLAVORS FROM SEEDS, FRUITS, LEAVES, AND BARK



Here are some of the principal spices and condiments we use in our foods: (1) Cloves, about twice natural size; (2) a branch of the Nutmeg tree, much reduced, showing flowers, leaves and fruit; (3) Allspice berries, highly magnified; (4) a flowering and fruiting branch of Red Pepper; (5) a Nutmeg; (6) a growing root of Ginger; (7) a few strips of Cinnamon bark; (8) Black Pepper berries, somewhat magnified; (9) Vanilla beans — the pods are seven or eight inches long; (10) Caraway seeds, highly magnified.

dient in curry powder, "the salt of the Orient," which is a mixture of powdered sago with various spices. One of the spices often used in curry is the cumin, which is also used as a substitute for caraway seed in seed cakes. Dill, commonly known in the East Indies as cake seed, is the dried fruit of a plant which grows as a weed in southern Europe. It is used in pickling, the most familiar use being for "dill" cucumber pickles.

Another group of seasoning plants is cultivated in gardens as kitchen herbs, their aromatic flavor being especially valued in meat cookery. Among these are the sweet-smelling common marjoram, thyme, whose fragrant leaves and flower-tips are so well liked in seasonings and sauces, and tarragon, used fresh or dried for pickling and for spicing vinegar. Savory, whose fine peculiar flavor is used in pickling and sauces; sage, whose distinctive taste gives zest to the dressing with which the Thanksgiving turkey is stuffed; and parsley, cultivated for its finely cut aromatic leaves and used for flavoring soups and for garnishing, are all well known flavoring plants. Bay, the dried leaves of a large evergreen shrub of the laurel family, is used in many forms of cookery.

NATURE'S *Most Expert* SPINNERS *and* WEAVERS

The orange garden spider is black with gleaming bands and dots of gold. Its web is strengthened with a zigzag ribbon of silk which shows here above and below the spider. The white object is a captured insect wrapped in silk.

SPIDERS, MITES, AND TICKS. The spinners, weavers, and civil engineers of the world of nature are the spiders. Few creatures have more interesting habits. Their silken webs are marvels of geometric design and workmanship. Spiders swing suspension bridges across streams and other obstacles. They travel great distances through the air on filmy balloons. When they want to return to earth they drop a landing "cable" and slowly descend.

One kind of spider builds an underground home protected by a hinged trap door. It has grooves on the underside by which the spider holds it down if anything tries to open it from above. When the spider leaves home, the door automatically springs shut. Another spider lives under water in an air-filled "diving bell." By carrying a bubble of air between its legs it can breathe as it hunts food under water.

Except in the polar regions and on the tops of high mountains where there is no insect life as food supply, spiders are found in all parts of the world. With their relatives the mites, ticks, daddy longlegs, and scorpions they belong to the class *Arachnida.* They are often mistakenly called insects. All adult insects have six legs and a segmented body in three parts. Spiders have eight legs; and the body is made up of only two parts—the fused head and thorax, called the cephalothorax, and the abdomen.

Another mistaken idea is that spiders are dangerous to handle. They are carnivorous, feeding upon insects and other living creatures. They kill their prey by clawing and injecting a poison into it. However, only two spiders in the United States are poisonous to human beings—the black widow, with its easily recognized red hourglass on the underside of the body, and the big, hairy tarantula.

Spiders, in fact, are beneficial to man, for they destroy millions of harmful insects such as houseflies, mosquitoes, and grasshoppers. The little orange garden spider is one of the best friends a gardener can have. Spiders play an important part in the *balance of nature* and should not be thoughtlessly killed.

Structure of the Spider

The fused head and thorax (cephalothorax) are joined to the abdomen by a slender stalk, the *pedicel.* The eight legs are attached to the cephalothorax. Each leg ends in two or three sharp claws. The hind claws in some kinds have combs by which the spider spreads silk over a struggling captive. In place of the antennae, or feelers, of insects, spiders have at the front of the head two claws called *chelicerae.* Near the tip of each claw is the opening of the poison glands. Another set of organs on the head are two *pedipalps* which may be mistaken for an extra pair of legs. There are no true jaws. Spiders seize their prey with the claws and pedipalps, inject poison into the victim and then suck it dry by means of a sucking stomach. It never swallows the solid parts. The mouth opening is between the base of the pedipalps. Spiders may have two to eight single eyes, depending on the species (for picture, *see* Eye). Some have two kinds of eyes for day and for night vision.

The spinning organs are near the rear of the saclike abdomen, on the underside. They consist usually of six spinnerets, to which is added in certain spiders another organ, the *cribellum.* Small spinning tubes, sometimes a hundred or more in number, are distributed over the surface of each spinneret. There are also a few larger tubes called spigots. Each tube and spigot is connected by a duct with a silk gland in

the abdomen. The cribellum, when present, is used to spin broad bands of silk composed of many threads.

How Silk Thread Is Produced

The silk is liquid when it issues from the spinnerets but it hardens on contact with the air. The spider cannot force the silk from her body in a stream. When she is spinning a web she draws the silk from the spinnerets with a hind leg. If she is forming an anchor or a dragline she presses her abdomen against the ground or wherever she wants to attach the line. The exposed silk sticks and then she simply walks away, drawing out the thread behind her. To produce the gossamer thread by which she floats through the air, she climbs to the top of a blade of grass or other exposed spot and turns the spinnerets upward. Air currents draw out the silk.

Spiders use the silk in many ways: to spin webs in which they trap their food supply; to line their nests or retreats; to wrap their eggs in protective cocoons; and to migrate on aerial threads carried by air currents. Wherever the spider goes it lays down a dragline. The line is useful to prevent falls from high places or to swing out of reach of an enemy. Many cobwebs are discarded draglines.

Man once used spider silk for the cross hairs in telescopes and other optical instruments, where extra fine strands of great strength were needed. Silk is being replaced for this purpose by platinum filaments and etched glass. Spider thread is stronger than silk produced by silk moths, but it cannot be obtained in sufficient quantities to make cloth.

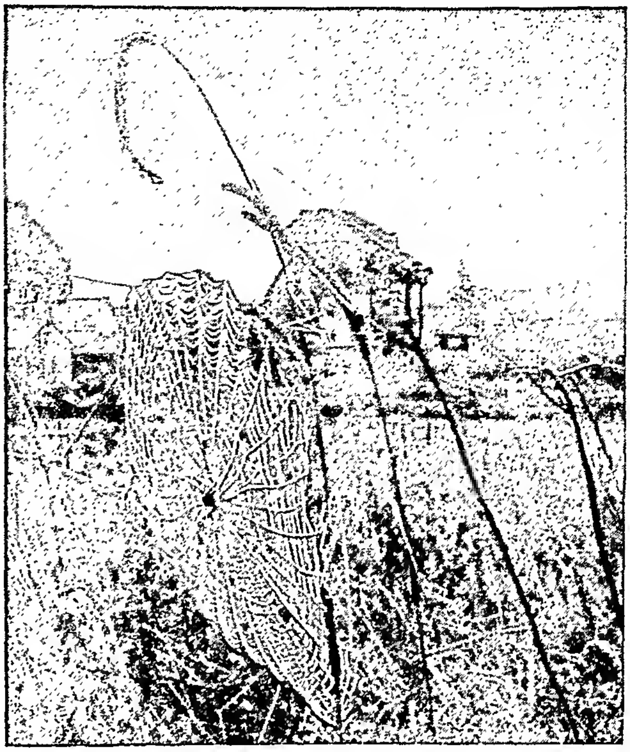
Webs are of several kinds. Grass spiders spin wide, flat, sheetlike webs over grass and shrubs and in the corners of buildings. They become dust covered, torn, and tangled, but the spiders constantly repair and enlarge them. At one side of the web is a funnel-like retreat with an opening at the bottom. Above the surface of the sheet are strung trap lines. Low-skimming insects run into the lines and fall onto the sheet, whereupon the spider rushes up the funnel and captures them.

House spiders spin irregular, tangled masses of silk in the corners of walls and ceilings. The hammock spider makes a netted, hammocklike sheet on plants. In the web, or at one side, a curled leaf or a tent of silk is used as a retreat. The dome spider spins a delicate, filmy dome three to five inches in diameter, hung in the center of a maze of threads.

The Making of an Orb Web

Most beautiful of all are the wheel-shaped orb webs. The common orange garden spider is among the most skillful of the orb-web builders. You can find such a web in almost any garden, stretched across a fence corner or between the low branches of shrubs. The female sits in the middle of her "parlor" awaiting visitors. Stand out of sight and watch what happens when something falls into the web. The spider's feet are in contact with the threads of the web and she immediately feels any vibrations in the threads. So remarkable is her sense of touch that she can tell the difference between, or at any rate respond differently to, vibrations caused by

AN ORB WEB IN THE EARLY MORNING SUN



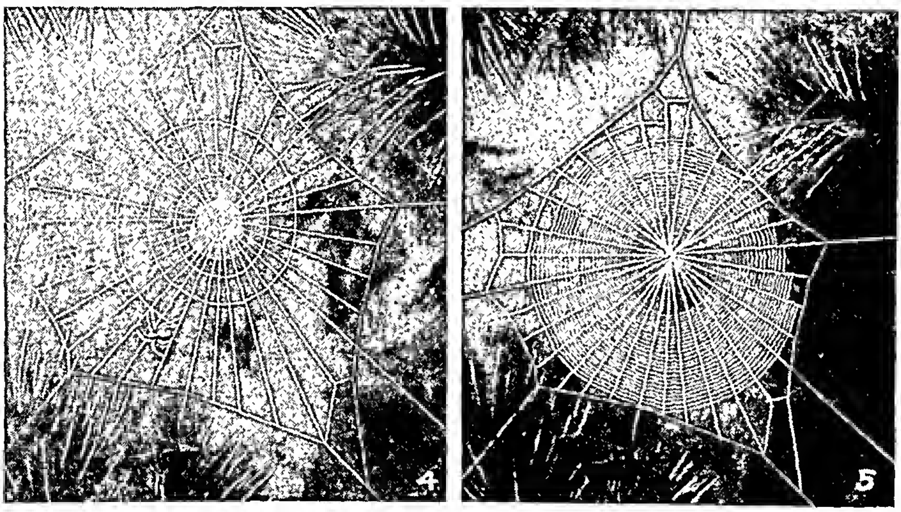
Few things in nature are more beautiful than the orb web of the garden spider, spangled with dewdrops and glittering in the early morning sun. Its design is perfect.

EGG SACS AND YOUNG OF THE GARDEN SPIDER

The garden spider wraps its eggs in waterproof sacs that open like a vase at the top. They are fastened with silk to the weed stalk.

Here newly hatched garden spiders are greatly magnified. At first they are colorless and translucent. Garden spiders usually hatch in autumn and remain inside the sac through winter.

ONE NIGHT IN A GARDEN SPIDER'S LIFE



These are actual flashlight photographs of a web under construction. Four and a half hours elapsed from the time the spider first began to spin until she finished, but she was temperamental and loafed three fourths of the time. After hanging the first cable (1), she built a sort of frame (2), in which she fitted spokes, as in a wheel (3). To hold the spokes in position, a spiral around the center was added (4), and finally the web was ready for its prey (5).

edible victims such as a fly, a dangerous enemy such as a wasp, a useless bit of leaf, or a male suitor.

Not all spiders wait in the center of the web. Some have retreats nearby and keep in touch with the web by means of a signal thread. Vibrations from the web travel along the thread to the hidden spider.

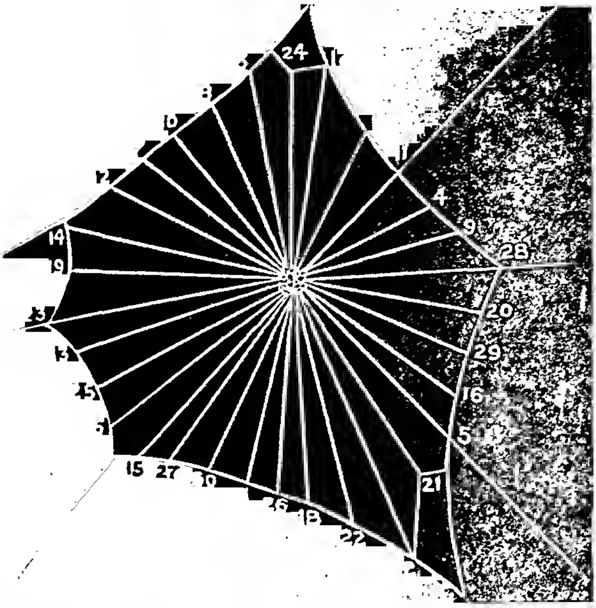
The orb web is made either early in the morning or at dusk. It is completed in a continuous operation, usually taking about an hour. The spider begins by dropping from one support to another, paying out a tiny silk cable and fastening it wherever she can. Soon she has an irregular space enclosed. She runs around these lines, pulling them with her hind foot to test their strength. When she has her space cut into four nearly equal parts like the quarters of a pie, she spins other spokes across the center. The crossings make a stout hub. Starting at this hub, she weaves a spiral line, crossing the spokes and gluing the joints. The spiral is carried around four or five turns. This is the temporary scaffolding, made of tough, dry threads like the spokes.

Now she starts near the outside edge of the wheel and circles around toward the center. This time she uses a different kind of silk. It is studded with sticky beads. It is this thread that catches and holds unwary insects. As she travels back to the hub the spider cuts the scaffolding away. When the new sticky spiral is complete, she spins new support lines from the outer rim of the web to the supporting branches and pulls them tight until the whole structure is as taut as a drumhead. If the web is destroyed, she builds another.

Sometimes you will find a spider's web bridging a small stream. How was the first thread carried across on which the web hangs? The spider simply released a long free thread from an elevated position. The thread was carried over by air currents and became tangled on the shrubs on the other side, then was drawn tight and fastened. Provided with this first cable path across the chasm, the spider found it easy to stretch the other foundation lines.

Newly hatched spiders migrate and thus scatter their kind and avoid overpopulation of their birthplace. The spiderling climbs to the top of a blade of grass or a hump of earth and releases a fine strand of silk. Warm air rising from the ground carries the

PUTTING IN THE SPOKES



This diagram gives the order in which a garden spider put in the spokes in the web shown on the preceding page. She did not go around the circle, but carefully added the spokes in such order that the strength of the net would be gradually increased without putting too great a strain on any part of it.

thread upward and the tiny aviator, no larger than a pinpoint, "takes off." Caught in rising air currents, thousands of them may be tossed together, forming a silky curtain of gossamer. In this way spiders reach islands hundreds of miles from the mainland. Charles Darwin, the scientist, in the 'Voyage of the Beagle' described how the rigging of the ship became coated with gossamer 60 miles from the coast of South America. Such flights in the United States usually occur in October and November.

Life History of the Spider

About 40,000 different kinds of spiders live throughout the world. They vary greatly in size. Some are no bigger than the head of a pin. The giant bird spider of South America may have a leg span of eight inches. Most of the familiar spiders in the United States have bodies about half an inch long. All spiders are miniature beasts of prey, but they capture their victims in different ways. Some lie in hiding and rush out at a passing insect. The wolf spider chases its prey. The jumping spider stalks and makes a pounce like a cat. Many roam about and seize whatever they meet. Brightly colored little crab spiders hide in flowers and seize the insects that come for nectar. The garden, house, and grass spiders trap their victims in their webs.

The female spider builds her own house, catches her own food, looks after her young, and lives most of the time in a busy solitude. Some males of the web-building species build their own webs, but they are less elaborate than those of the female. The male is smaller than the female. She barely tolerates her mate and sometimes even eats him.

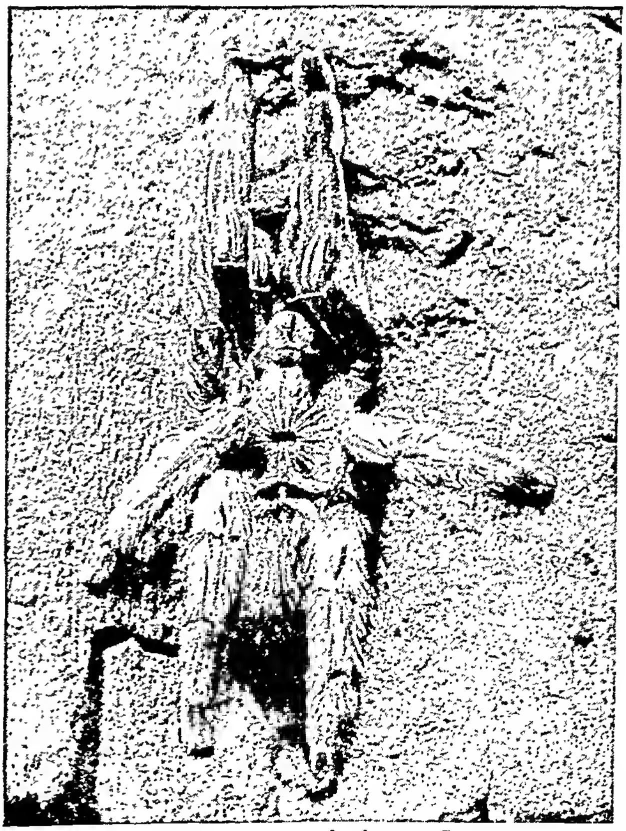
The male courts his future wife with considerable caution, keeping several of his eyes on her and the other eyes on a means of quick retreat if she is not interested in his advances. Certain male jumping spiders, which are covered with hairs of brilliant colors, perform the most extraordinary antics before the females, leaping and swaying and displaying their beauty. These dancers remain at a safe distance, for if they fail to find favor they are likely to be pounced upon and eaten. If they escape with no worse than the loss of a leg they need not worry, for spiders can grow new legs when needed.

The female lays a mass of eggs, from 40 or 50 to 100 at a time, and spins around them a silken sac. She hides the sac under stones, in the litter of woodland floors, or under the loose bark of trees or attaches it to plant stems. The wolf spider carries her egg sac wherever she goes. (For picture, *see* Nature Study.) After the spiderlings hatch they ride about on the mother's back until they are able to care for themselves.

The eggs hatch in the fall or spring. The young mature in the spring and early summer, growing by a series of molts; that is, by casting off the old skin. Most of them die before winter.

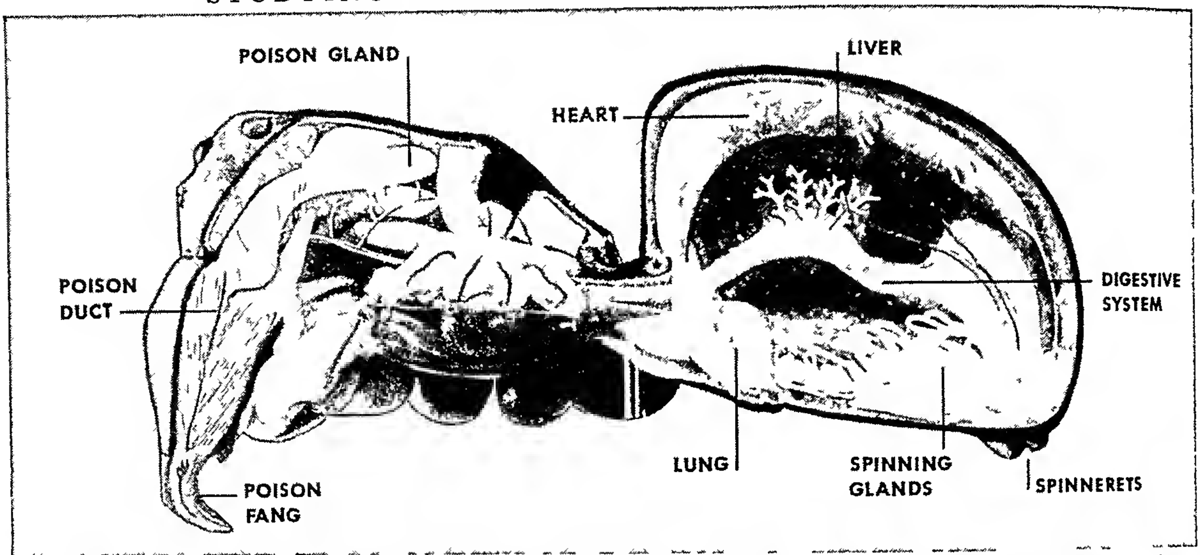
Spiders that hatch in the fall in northern climates remain inside the egg sac all winter. House and garden spiders are examples. In their exquisite silken bed the newborn spiders lie dormant in cold weather. In warm weather they arouse from sleep and devour one another. By spring only a few of the strongest remain alive. A few adult spiders live through

THE SOUTH AMERICAN BIRD CATCHER



The bird spider is the largest species known. Some have bodies three inches long, and their strong hairy legs have a spread of seven or eight inches. They feed on insects and small birds.

STUDYING THE SPIDER WITH A MICROSCOPE



This drawing shows the location of the spider's principal internal organs. It wounds its prey with the claws and kills it by the poison which flows from the duct into the claw. It sucks its victim dry and casts aside the solid parts.

The spinnerets (left) are usually six in number. The tip of the spinneret is the spinning field. Over the surface of the spinning field are many tubes through which the silk issues. Each tube is connected by its own duct to a silk gland. The mouth opening (center) is between the base of the two leglike organs (pedipalps). The two claws (chelicerae) are above and in front of the mouth. With the comblike teeth on the claws of the hind foot (right) the spider manipulates the silk threads

the winter wrapped in silk blankets hidden in any sheltered place. Grass spiders winter only as eggs.

Some Interesting Kinds of Spiders

Certain large, hairy spiders are popularly known as tarantulas, though actually there are several different kinds. The bite of the famous tarantula of southern Europe was supposed to cause the dancing madness called *tarantism* (*see* Tarantula). The huge bird spider of South America belongs to this group. Other interesting members of the family, found in the southwestern United States, are the trap-door spiders. They dig holes in the ground and conceal the opening with hinged covers.

Even more ingenious is the water spider which lives among the plants at the bottom of clear quiet ponds. There it builds a thimble-shaped dome of waterproof silk, fastened mouth downward to the stem of a plant or wedged in the crevice of a stone Then it goes to the surface and catches air bubbles on the hairs of its stomach and between its legs and carries them down, brushing them off into the submerged cell until it is filled to the brim with air. To this home the water spider brings whatever prey it catches. Here too its eggs are laid and hatched, out of the way of all enemies.

The Black Widow Spider

The poison of a spider is rarely, if ever, directly fatal to man. It destroys cells near the point of the bite and thus may bring about a fatal general infection, or "blood poisoning." The black widow, hourglass, or shoe-button spider has a bad reputation in the United States for causing deaths in this manner. The female is the dangerous one. She is about half an inch long and coal black, marked with red or

yellow or both. She usually has on the underside a patch of color shaped like an hourglass and red spots on the back. The male is half the size of the female and more conspicuously marked. These spiders are found under logs and stones and around outbuildings. They are most numerous in the Southern states.

The Daddy Longlegs

A familiar relative of the spider is the daddy longlegs, or harvestman. It is easily recognized by its extremely long legs. The body appears to consist of a single region because there is no constriction between the cephalothorax and the abdomen. Actually it is divided into nine segments. These creatures have no silk glands and make no nest or retreat. They remain during the day in dark crevices or on shaded tree trunks, coming out at night to forage for food. In the fall they lay their eggs in the ground by means of an egg-laying organ, the ovipositor, which bores into the earth. The adults die and the eggs remain in the ground during the winter, hatching in the spring.

Those Tiny Pests—Mites and Ticks

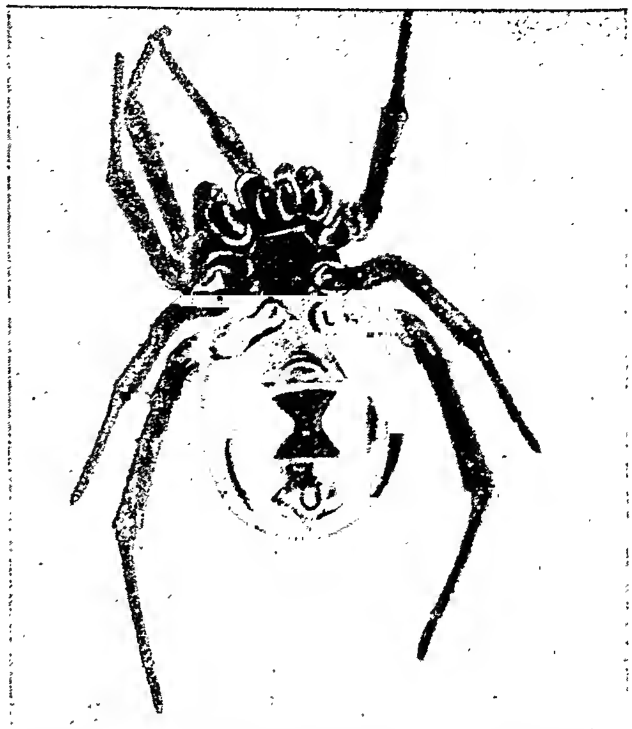
Mites and ticks are distinguished from spiders in having the abdomen fused with the cephalothorax. This gives them a more or less saclike appearance. As a rule they have four pairs of legs, although the newly hatched young have only three pairs. Most mites are extremely small, the largest being only half an inch in length.

Birds and mammals are often infested with mites. The poultry mite sucks the blood of chickens. Others merely eat shreds of skin and the feathers of birds. Itch mites produce the disease of domestic animals called scabies, or mange.

Of the species that attack plants, the little scarlet mite called "red spider" is the best known. It is a common pest in greenhouses. The four-legged gall mites produce swellings, or galls, on the buds and leaves of plants. Some mites injure food products, such as cheese, sugar, flour, and dried meats.

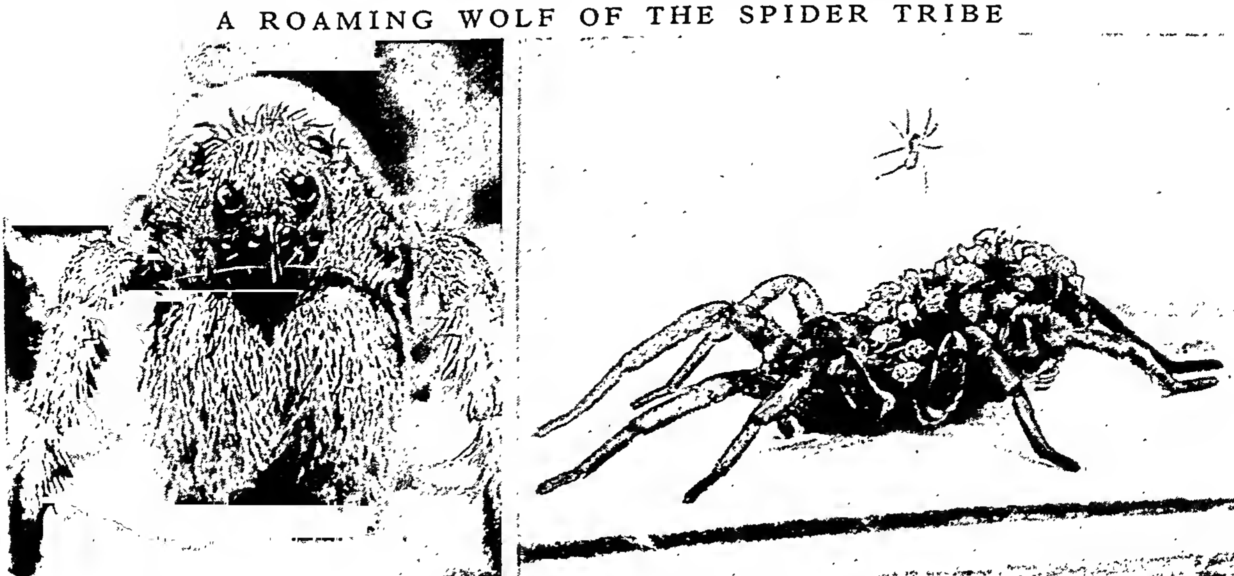
The water mites have legs fitted with long hairs for swimming. Some are free living, some cling to aquatic insects, and others live in the gills of mollusks. Many mites are harmless, since they feed on decaying matter. A few are beneficial, destroying the eggs of grasshoppers and feeding on plant pests.

THE DANGEROUS BLACK WIDOW



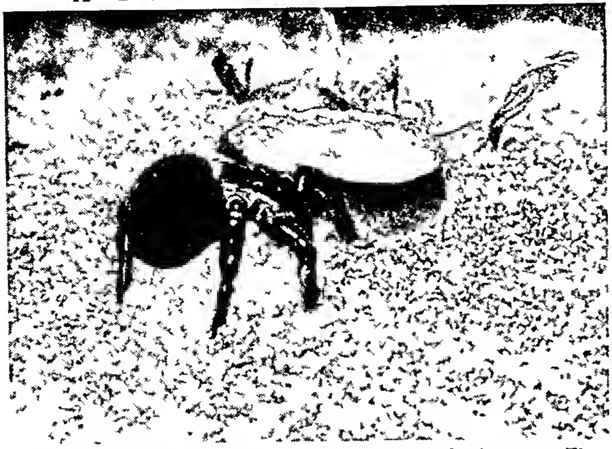
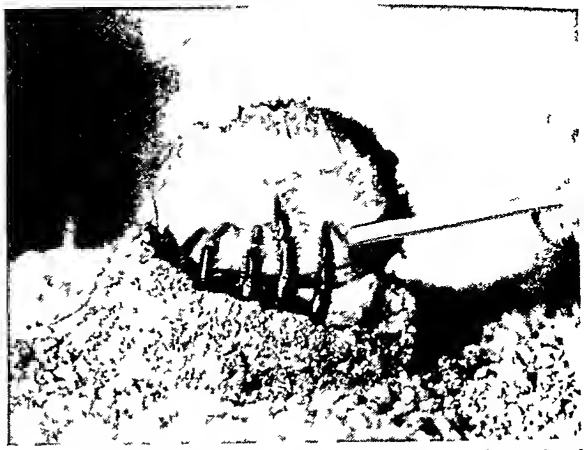
The female black widow spider is one of the two spiders in the United States that are poisonous to man. It is black, with a red or yellow mark shaped like an hourglass on the underside.

A ROAMING WOLF OF THE SPIDER TRIBE



If you were an unfortunate grasshopper this is how the face of a wolf spider (left) would appear to you. This is a long-legged brown spider that hides under grass and leaves during the day and becomes active toward evening. It builds no web or shelter but roams about and catches its prey by chasing it down. The female (right) carries the egg sac wherever she goes. When the eggs hatch the spiderlings ride on her back for several days. Their bodies at this early age are white and translucent.

A TRAP DOOR LETS THE SPIDER IN AND KEEPS ENEMIES OUT

At the left is a trap-door spider about to enter its burrow. The door is neatly hinged and carefully beveled to fit the opening. Inside is a tunnel. Its wall is coated with earth and the spider's saliva and lined with a sheet of silk. The underside of the door is also silk lined. The top side is camouflaged with earth and moss so that it is almost invisible. The spider pulls the door shut (right) by hooking its claws into grooves on the underside This spider is related to the tarantulas.

The largest mites, those belonging to the family *Ixodidae,* are commonly called ticks. They suck the blood of mammals, birds, and even reptiles. The southern cattle tick transmits tick fever, or Texas fever, from one animal to another.

Some That Prey on Man

Man is annoyed by several species of mites and ticks. One minute parasite, a wormlike mite, lives in the hair sheaths of the human skin. The redbugs of the Southern states burrow under the skin and cause serious irritation. Closely related to them are the young of harvest mites (commonly known as chiggers). They occur from New York to Minnesota and southward. They attach themselves to the skin but do not burrow in. The disease known as Rocky Mountain spotted fever is also transmitted by a tick.

The life story of the wood tick is typical of the parasitic kinds. The adult deposits numerous eggs on the ground. About a month later they hatch into small six-legged creatures called seed ticks. These crawl up vegetation and await the coming of a suitable host, such as a bird or mammal. If the ticks succeed in attaching themselves, they insert their beaks, fill with blood in four or five days, then drop off, molt their skins, and gain an extra pair of legs The nymph, as it is now called, has habits similar to those of the seed tick, attaching itself, feeding, and again dropping off and shedding the skin, thus attaining the adult stage. The change from one stage to another can take place only after a full meal of blood, and the female too has to gorge herself on blood before laying eggs.

Scientific Classification

Spiders belong to the order *Araneida* of the class *Arachnida.* The word Arachnida comes from the name of a Greek maiden, Arachne, who was turned into a spider by Athena for daring to compete with her in spinning (*see* Athena). The chief families of the order are: *Argiopidae,* the orb weavers, including the orange garden spider, *Miranda aurantia; Agelenidae,* including the grass spider, *Agelena naevia; Theridiidae,* including the common house spider, *Theridion tepidariorum,* and the black widow, *Lactrodectus mactans, Thomisidae,* crab spiders; *Lycosidae,* wolf spiders All these belong to the superfamily *Argiopoidea* Tarantulas and their relatives belong to the superfamily *Avicularioidea.* Daddy longlegs belong to the order *Phalangida;* mites and ticks to the order *Acarina.*

The TWIN CRAFTS *That Produce* CLOTH

SPINNING AND WEAVING. Machines in modern textile factories turn out many miles of beautiful and useful cloth each day. They are among the most complicated of all the machines used in industry, and they work with lightninglike speed. Trained, skillful workers operate them.

Yet cloth can be made without any machines at all. The two basic processes involved—spinning and weaving—are very simple. People understood them well long before they knew how to read and write. They made beautiful fabrics thousands of years before machines existed.

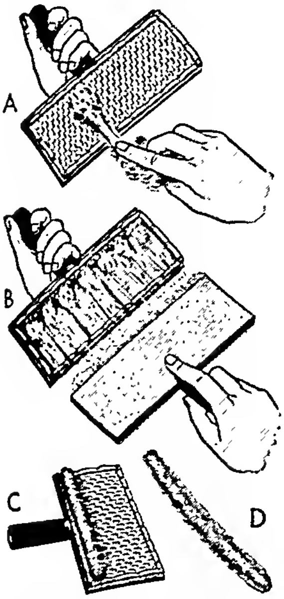
Weaving is the interlacing at right angles of two sets of fibers or other long, narrow, flexible materials Spinning is the process by which fibers are drawn out and twisted into string, yarn, or thread

Weaving Came before Spinning

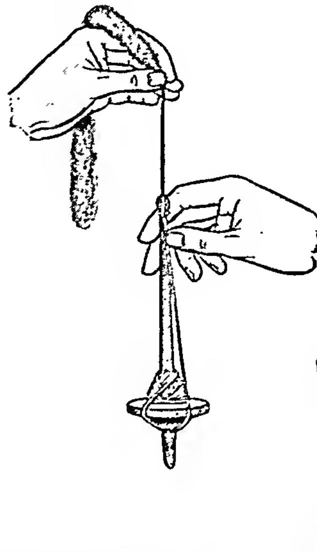
The first weavers were probably men of the Old Stone Age who thrust branches into the ground at intervals and laced additional branches in and out between them to make a windbreak. Early in the New Stone Age people learned to form the windbreak into a circle or square and to roof it over to make a house. They wove other useful things of reeds, roots, and branches: fish traps, mats, and baskets.

The New Stone Age period came at different times in different parts of the world. Almost everywhere during the period people learned to spin, using whatever

THE AGE-OLD WAY OF SPINNING WOOL WITH DISTAFF AND SPINDLE

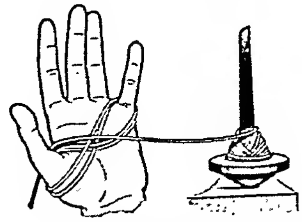


1. The first step in the age-old way of spinning wool was to clean it and straighten the fibers by *carding.* This was done by placing it on a toothed card (A). Then it was worked between two cards (B) until it was a roll of straightened wool (C) called a *sliver* (D).

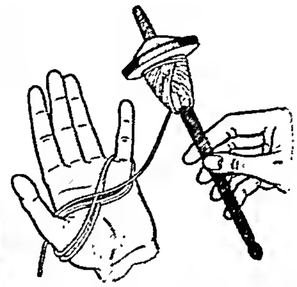


2. The spinner drew a length of fiber out of the sliver and fastened it to a weighted spindle. The spindle was twirled and it twisted the fiber into yarn. To use the spindle pictured here, previously made thread was fastened as shown, and new wool was twisted into the end.

3. The spinner carried the new wool on a *distaff,* under one arm. She spun a few inches of it and then added more until the spindle touched the ground.



4. The spindle was set in a rest, and the new thread was wound on the left hand.



5. The thread was wound from the hand to the spindle, gradually making a cone-shaped mass. Then more thread was spun again and again until the spindle was full.

Wool was spun, as shown above, from prehistoric times until the late Middle Ages. Details of preparing the wool and the design of the spindle and whorl varied, but the work was all done by hand. Then came the first helpful invention, shown below.

fibers were available. The first spinning was probably no more than a crude twisting together of coarse fibers—such as those of jute or hemp—done without tools, to make fishing lines and other kinds of string and rope. But by the end of the New Stone Age, most peoples had developed the spindle and become expert at using it. For thousands of years this tool, without improvement, was the only means of spinning.

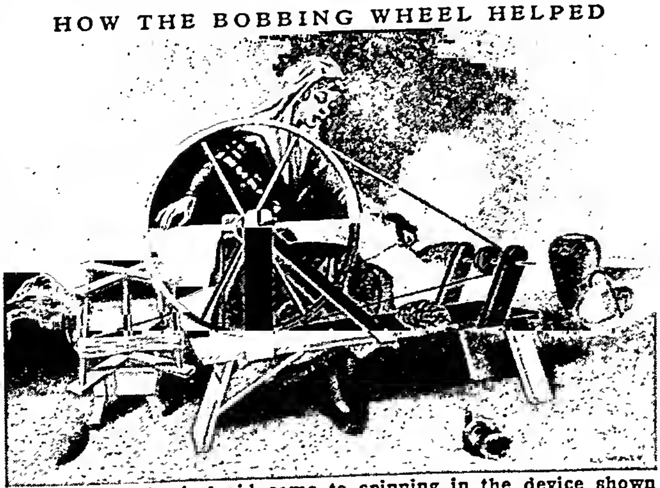
The first spindle was probably just a notched stick on which the spinner wound up her string or thread after she had twisted it with her fingers. In time spinners learned that if they secured the thread in the notch and let the partly filled stick dangle, they could twirl it and it would do the spinning more evenly than their fingers could. Eventually some enterprising spinner fastened a weight to the lower end of the spindle to make it whirl better. Such weights came to be known as *spindle whorls.* Often they were baked-clay discs perforated through the center so that they would slip up over the lower end of the spindle.

A tool to help the spinner was the *distaff,* a longer, heavier stick than the spindle. She used it to carry fibers prepared for spinning, binding a mass of them loosely to the top end. She held the distaff under her arm or thrust it into her belt. Using a distaff, she could walk about as she spun, and she had both hands free for drawing out fibers and handling the spindle.

Early spinners did not all use a distaff. Egyptians sat with a pile of prepared flax fibers in front of them. They drew these out into a thick, loosely twisted strand called a *roving.* This was wound into a big ball. They kept the ball in a jar of water as they drew out the roving and spun it into yarn.

In ancient India and across the world in Peru, spinners working with cotton used a small

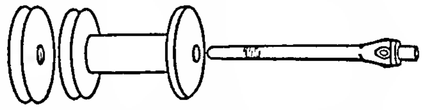
HOW THE BOBBING WHEEL HELPED



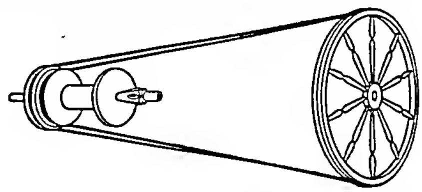
The first mechanical aid came to spinning in the device shown above. The spindle was mounted on a shaft with a small pulley, and the pulley was spun by a drive belt from a larger wheel. The operator turned the large wheel by hand. The stand could carry a distaff for holding new wool to be spun into soft yarn. If yarn was to be spun into a hard thread, it might be wound on a revolving stand. The bobbing wheel shown here was used in England about 1400. It was called a Jersey wheel.

THIS WHEEL BROUGHT THE HIGHEST DEVELOPMENT OF HAND SPINNING

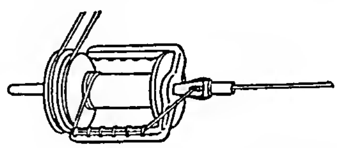
An American colonial spinner is using the Saxony wheel, so called from its invention in Germany in the 16th century. The wheel was turned with a crank from a foot treadle. Thus both hands were free for feeding fiber to the end of a hollow spindle. The fiber was spun by the mechanisms shown at the right.



The spindle (right) was the heart of the Saxony wheel. A drive pulley (left) fitted on one end. The other end was bored to receive the spun thread; it entered the hole in the end of the spindle and emerged through an eye. A spool (middle) fitted loosely on the spindle; driven by another pulley, it wound the thread as it was spun.



The spindle pulley and the spool pulley were connected to the large wheel by driving cords. When the large wheel was turned by working the foot treadle, the spindle and the spool turned in the same direction but at different speeds.



Attached to the spindle and turning with it was a two-armed *flier*. Inside each arm was a series of hooks called the *heck*. Spun thread ran from the eye in the spindle through the heck and then onto the spool. Running at a different rate than the spindle and flier, the spool drew in and wound the spun thread. Any hook on either arm of the flier could be used to wind the thread.

spindle set in a shallow bowl of water. The water kept the cotton fibers moist, and the spinner could draw them out to gossamer fineness. She twirled the spindle with her fingers as it stood in the bowl. A dangling spindle would have broken such fine yarn.

The idea of a spinning wheel originated in India. Some one thought of supporting a spindle horizontally in a frame and turning it by means of a belt connecting it with a large wheel. The first type of spinning wheel in Europe was the bobbing wheel, illustrated on the preceding page. The spinner alternately spun her yarn and wound it up on the spindle. The Saxony wheel, shown above, was an enormous improvement. It twisted yarn and wound it at the same time. Spinning methods did not develop further until the Industrial Revolution.

Preparing the Fibers

Getting fibers in condition to be spun involved many long, tedious jobs which machines do today. Workers soaked stalks of flax in water and then pounded the woody parts out of the fibers with stones or wooden mallets. They untangled the fibers and straightened them out with a comblike tool that came to be known as a *hatchel* or *hackle*. People picked the seeds out of cotton by hand. Those using wool sheared their sheep with knives at first and later with shears. Then they worked masses of wool between two brushlike *cards*. Ancient cards had leather backs and thorn bristles. Carding cleaned the wool and also made its fibers lie parallel.

WEAVING AT A PRIMITIVE INDIAN LOOM

This Navajo woman is not using the shed stick (S) or the heald rod (H) described in the article because she is filling in a narrow section of the pattern.

The Need for a Loom

The first weavers did not need a frame to hold their weaving. Branches, reeds, and roots were stiff enough to be easily managed. But as soon as people began to weave with thread, or yarn, they had to invent a *loom*. This is a frame for holding a set of lengthwise yarns, called *warp*, in place while the weaver laces a yarn

or set of yarns crosswise between them, back and forth, to fill out the fabric. The crosswise yarn is called *filling yarn, woof,* or *weft.*

Early Looms Were Simple

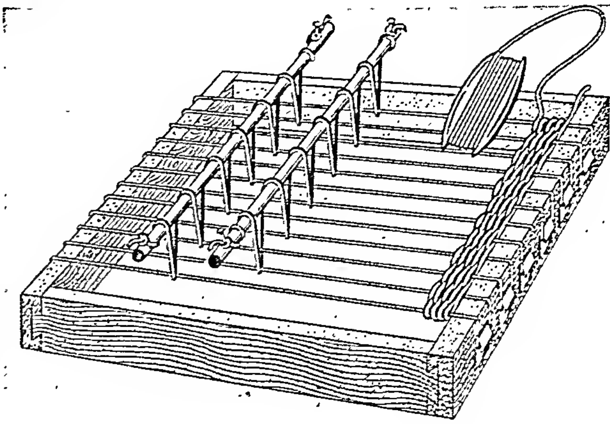
The most primitive loom was warp-weighted. The weaver tied warp yarns to a horizontal pole suspended from the branch of a tree or supported by two uprights. She weighted their lower ends singly or in bunches with stones or clay weights. Weaving began at the top of the loom. The Lake Dwellers of Europe, a Stone Age people, used warp-weighted looms. Penelope's loom, as pictured on a Greek vase of the 5th century B.C., was of this type.

Many primitive American-Indian looms were similar to the warp-weighted loom but had the lower ends of the warp yarns fastened to a pole instead of to weights. The weaver sat down to work and began weaving at the bottom of the loom. As the weaving progressed the loom was lowered from the top.

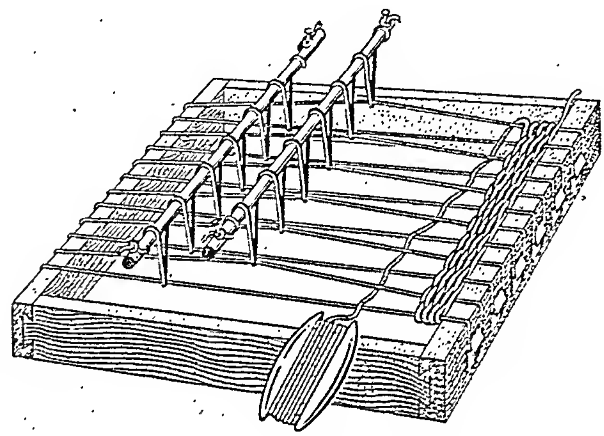
The Navajo loom shown on the preceding page is of this type. It contains the most primitive aids to help the weaver pass her shuttle, which carries filling yarn, in and out between the warp yarns. These are a *shed stick* and a *heald rod,* or *heddle.* The shed stick is inserted crosswise through the warp, over the odd and under the even yarns. The heald rod has loops through which the odd warp yarns pass. When the weaver pulls the shed stick toward her, the even threads come forward, making a *shed* for passage of the shuttle in one direction. When she pulls the heald rod toward her, the odd threads come forward, making a *countershed* for return of the shuttle. Later looms had *heddles,* or harnesses, worked by pedals or other mechanisms.

The Egyptian Loom

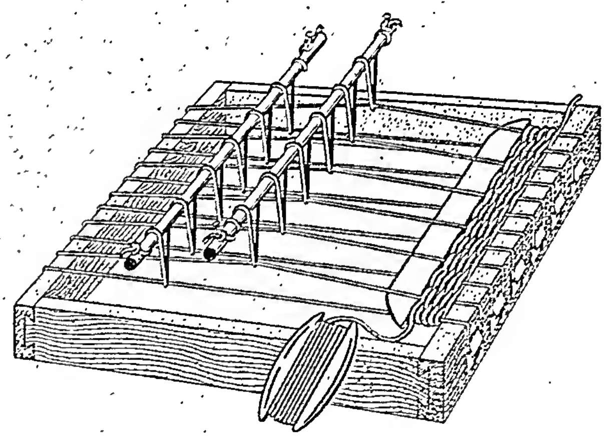
The ancient Egyptians had a *two-barred loom* on which they



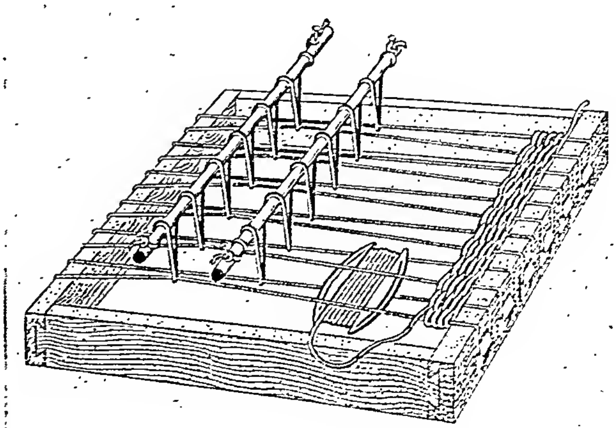
1. This simple practise loom is arranged for plain weaving. The weft thread is to be passed back and forth, crossing alternately over and under the warp threads. To achieve this, alternate warp threads are attached to two heddle rods. On this small loom the shuttle is of a simple bobbin type. (For simplicity, only 12 warp threads are shown, widely spaced.)



2. Here the right-hand heddle rod is up, and has lifted the warp threads attached to it. The weft thread has been passed through the space (called a "shed") between the sets of warp threads.



3. The newly passed length of weft thread is pressed down firmly against those already woven with a wooden strip called a *batten.*



4. The right-hand heddle rod is lowered, and the left-hand rod is pulled up. This "changes the shed," as weavers say. Warp threads which were up are now down, and vice versa. Now the weft thread is passed through the new shed. The "under and over" order of crossing the warp threads will be the reverse of that shown in picture 2.

could weave long lengths of cloth. The weaver tied long warp yarns to one bar, or beam, and then rolled them up on this beam (the warp beam) until it held a warp of the desired length. The free ends of the warp yarns were attached to another bar, called the cloth beam. The two beams were held apart by a framework to leave a taut length of warp between them. The loom might be either vertical or horizontal. Weaving began at the cloth beam. As cloth was woven, it was rolled up on this beam and more warp was unrolled from the warp beam.

The first shuttles were small sticks wound with filling yarn. The Egyptians enclosed the stick in a smooth, flat, boat-shaped container. Modern shuttles developed from this model.

Primitive weavers used a *weaver's sword.* This was a long flat piece of wood with which they beat each length of weft, or filling yarn, close to the preceding one to make a firm fabric. The modern equivalent is the *batten,* illustrated on the preceding page.

Looms Become More Complicated

The looms of Renaissance Europe and Colonial America were horizontal or slanting two-barred looms with foot pedals to operate the harnesses. The weaver's hands were free to manipulate the shuttle and filling yarn. Often there were several harnesses to make simple pattern weaving possible.

The draw loom, invented in China, appeared in Europe during the Renaissance. A separate cord controlled each warp yarn, and any combination of warp yarns could be lifted to form a shed. Elaborate pattern weaving was possible. The cords were fastened to a bar at the top of the loom. Different groups were looped with string and bunched together to make sheds. A draw-boy crouched at the top of the loom, near the ceiling, where he would pull the strings at the weaver's command. The Jacquard loom, a modern power loom developed from the draw loom, bears the name of a man who worked as a draw-boy before he was 10 years old (for picture, *see* Rugs and Carpets).

From the 18th century, the story of spinning and weaving is part of the Industrial Revolution. Men invented machines to carry out hand processes and ways of using water power and later steam to make the machines move (*see* Industrial Revolution). But the essential processes—the things that have to be done to make cloth—remain the same. (*See also* Fabrics; Textiles.)

THE BRIDAL WREATH

The dainty white sprays of the bridal wreath make this a favorite variety of spirea. It gets its name from the fact that in temperate climates it comes into full bloom in June, "the bride's month."

SPIREA (*spī-rē'ȧ*). In meadows and gardens throughout the temperate parts of the Northern Hemisphere we find the flowering shrub called spirea. All the species—about 70—bear graceful clusters of tiny white or pink flowers. The plumy bridal wreath, the woolly-leaved hardhack, or steeplebush, and the Vanhouttei are among the best known. Common varieties are used for hedges.

The spirea's five-petaled flowers grow in clusters In the center of each flower are a number of little stamens which give the clusters a dainty, lacy appearance. Spirea is a large genus of the rose family. Scientific name of bridal wreath, *Spiraea prunifolia,* of hardhack, *Spiraea tomentosa;* of Vanhouttei, *Spiraea vanhouttei.*

SPIRITUALISM. Can the spirits of the dead communicate with the living? The belief that they can and do has been widely held at all times and among all peoples. In modern times this belief has crystallized into an organized doctrine called spiritualism

The modern spiritualistic movement began in 1848 when Kate and Margaret Fox reported that they heard mysterious knocks in their house at Hydesville, N. Y. They interpreted these "messages from the spirit world" and became the first spiritualistic "mediums." Thus began a movement which soon became world-wide.

At spiritualistic "séances," or sittings, many strange occurrences take place. While the medium is in the trance state, raps and other sounds are heard, lights appear, and heavy objects move. By such manifestations, and by using the voice of the unconscious medium, departed spirits are supposed to convey messages to the living.

By 1880 the movement had grown so large that it attracted the attention of scientists. In 1882 the Society for Psychical Research was organized in England to study "supernormal" phenomena. Although many mediums were found to use trickery, there remains a considerable amount of apparently genuine phenomena which have not yet been satisfactorily explained

SPOKANE (*spō-kăn'*), **WASH.** Limitless electrical energy for turning factory wheels, operating mines, grinding wheat, and running trains, and a network of railway lines radiating in all directions have made Spokane the second city of the state and the financial and distributing center of the "Inland Empire." This great region extends from the Cascades into the Rockies of western Montana, and from British Columbia to Oregon. It has billions of feet of standing timber and rich mineral deposits to the north and east of Spokane, the fertile wheat fields of the Palouse and the Big Bend country to the south and west, and the grazing lands and orchards of the Yakima Valley beyond the Big Bend White pine, lead, silver, wheat, apples, potatoes, sheep, hogs—a wealth of products comes from this empire to Spokane for shipping to all parts of the country. Much of this area is already irrigated, and the Columbia Basin Irrigation Project will make agriculture possible on an additional 1,000,000 acres.

Spokane is in eastern Washington less than 20 miles from the Idaho border. Its situation on the plateau between the Cascades and the Rockies, at an elevation

of 1,898 feet, gives it an invigorating though equable climate. The Spokane River pours over Spokane Falls in the center of the business district. Here and at another falls within the city are two of the many power plants which supply electricity throughout the region. The city's industries produce such goods as meat, flour, bread, crackers, lumber, paper, matches, pulp, aluminum, electrical goods, and auto bodies.

The water supply of the city is pumped from a subterranean river below the Spokane River. On the high rimrock above the river are many fine parkways. Some of the city's most beautiful homes are perched on the slopes of the valley and along these drives. Near the north end of Downriver Parkway is the mile-long Deep Creek Canyon. Its walls tell stories of lava floods and scouring glaciers. Among the thousands of acres of parks are Cliff Park, which affords a good view of the valley, and Manito Park, famous for its sunken gardens.

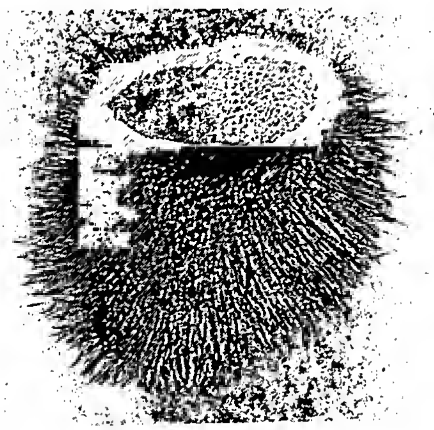
The eastern division of the Washington State Museum has a fine collection of Indian arts and handicrafts. Spokane's colleges include Gonzaga University (Catholic), Whitworth College (Presbyterian), and Holy Name College (Catholic).

Geiger Field is the municipal airport. It serves two transcontinental airlines and an interstate air service. Felts Field is a municipal training center. Fairchild Air Force Base is a headquarters of the United States Air Force. Near the city are an army maintenance depot and a naval supply depot. Spokane is the site of a veterans' hospital.

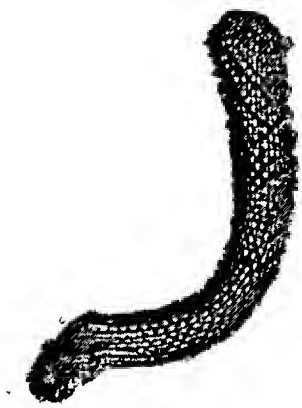
The first permanent settlers on the site of Spokane were J. J. Downing and S. R. Scranton. They built a sawmill near the falls in 1871. In 1873 J. N. Glover bought out these men and laid out the town of Spokane Falls. Spokane is an Indian word meaning "children of the sun." The first public school was built in 1878, and the first newspaper was started in 1879. In 1883 the Northern Pacific reached the city, first of five transcontinental railroads now serving it.

In 1881 the community was incorporated as a city. In 1890 "Falls" was dropped from its name, and in 1910 Spokane adopted a commission government. Population (1950 census), 161,721.

HORNY SPONGE



GLASS SPONGE



VENUS'S-FLOWER-BASKET

SPONGES—*Simple* SEA ANIMALS

SPONGES. The most primitive of the many-celled animals are the sponges. They eat, they grow, and they reproduce, but they are very sluggish and they have no sense organs or nerves. They are without tentacles or leglike parts, and adult sponges cannot move from place to place.

Sponges always live in water. In the body wall are many pores through which water enters. At one end are one or more special pores called *oscula* through which water finally escapes. Through the pores the water carries food and oxygen to the sponge and carries wastes away through the oscula. The presence of pores gives the sponges the group, or *phylum*, name of *porifera*, or pore-bearing animals.

Most sponges live in the sea. A few live in fresh-water ponds or streams. They usually attach themselves to a rock or other solid or to the sea bottom itself. In shape they may be very irregular or they may have definite shapes resembling a ball, a glove, a cup, or a cone. They vary in size from pinhead dimensions to large masses three feet long and a foot wide. They are found in many colors.

The skeleton keeps the living sponge from collapsing into a jellylike mass by supporting the soft cells of the body. In some species of sponges the skeletons are made up of *spicules*, or needlelike forms, of calcium carbonate or silicon. Others are made up of *spongin* fibers. Spongin is a protein material resembling silk in its chemical composition. In preparing sponges for market, the soft living cells are cleansed away; only the spicule or spongin skeleton is sold.

Sponges have many uses. In the home they are used in the kitchen and in the bath and for washing walls and ceilings. Garages use them for washing cars. Surgeons employ them for absorbing blood and other body fluids. Throughout industry, businesses, and in various arts they are used wherever a cleaning or absorbent material is needed.

Many types of synthetic sponges are now sold. They have the advantage of being cut to the exact size and shape wanted. Among the materials used are vinyl, viscose, cellulose, and rubber. None equals the best natural sponges for softness and durability.

There are about 3,000 species of natural sponges, but only about 13 are commercially important. All the commercial sponges grow in tropical or semitropical waters. The following are the most common:

Sheep's-wool, or *wool*. These sponges are found in the Gulf of Mexico, the Caribbean Sea, and in the adjacent Atlantic Ocean. They vary widely in appearance, but generally the surface is tufted with bundles of fibers. The color of the living sponge is black. They grow to 18 inches or more in diameter and are soft, absorbent, and durable. Most common bath sponges are sheep's-wool.

Yellow. The yellow sponges are found mainly in the Caribbean. They are very elastic, but they are harder than the wool sponges, less absorbent, and drain more readily. They are regular in shape and grow to a maximum diameter of 18 inches. The surface is covered with a nap of short hairs.

Velvet. These sponges grow mainly in the Florida straits and in the waters off Jamaica and the Bahamas. They are cake shaped, more broad than high. On the upper surface are two or three ragged semicircular vents, divided inside into a number of circular openings. Velvet sponges are very soft to the touch, but they are less compressible and less absorbent than the sheep's-wool.

Grass. The grass sponges are taken in great quantities from the waters off Florida, Mexico, the Bahamas, and Cuba. They have a wide variety of shapes and textures, but all are of low quality and harsh to the touch. The *anclote grass*, best of the grass sponges, is excellent for cleaning oily or greasy surfaces found in various industrial operations.

THREE CALCAREOUS SPONGES

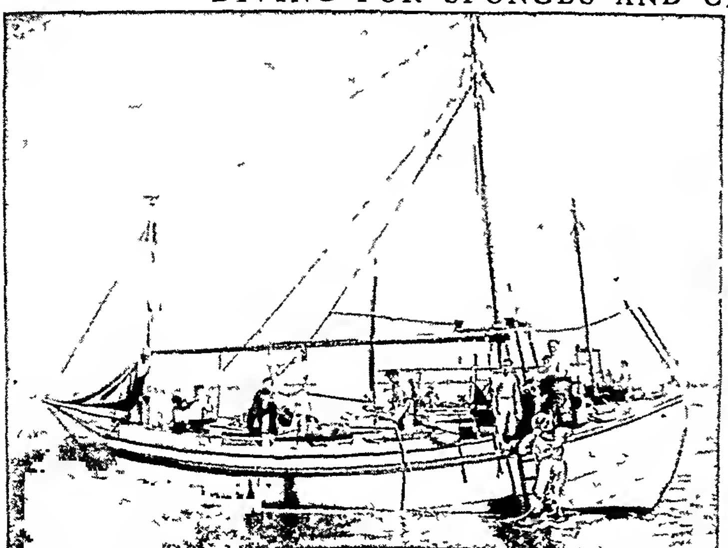
At left are the vase-shaped stems of *Sycon;* at right, the much-branched *Leucosdenia;* at top, the *Halichondria panicea.*

Glove. This sponge gets its name from a vague resemblance to a many-fingered glove. Glove sponges are found mainly in the seas off Florida and the Bahamas. They are soft and elastic, but the fibers are very weak.

Reef. Reef sponges vary in shape, but all are covered with a network of small round holes, with short bundles of fibers on the ridges between the holes. They are taken in Bahaman and Cuban waters

Hardhead. Hardheads come from waters off the Bahamas, British Honduras, Haiti, and Cuba. They are elastic but harsh and not very compressible.

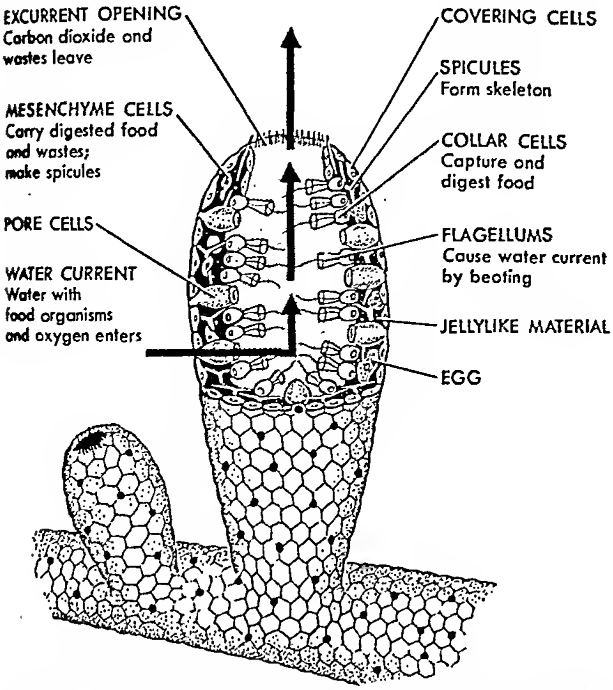
DIVING FOR SPONGES AND CLEANING THEM



This boat operates in the Gulf of Mexico off Tarpon Springs, Fla. The diver is coming aboard after working on the sea bottom.

These men are cleaning the sponges by removing the soft body tissue, leaving only the spongin skeleton to be used as a sponge

HOW A SIMPLE SPONGE FEEDS



Sponges are like living filters. They strain out tiny food organisms from the water currents that constantly flow through them.

Wire. The wire sponges are found off the west coast of Florida. They have an open surface and thick, bristly fibers. The fibers are harsh and weak and the sponges are easily drained.

Turkey cup. These cup-shaped sponges are taken mainly in the eastern Mediterranean. Both pores and oscula are numerous and fibers are few. This makes the Turkey cup fine, soft, and elastic.

Turkey toilet. These sponges resemble the Turkey cups, except that they are less compressible and not as soft and fine. They are also found in the eastern Mediterranean Sea.

SPONGE MARKET

At the Tarpon Springs Sponge Market the catches are auctioned off to be distributed for many nation-wide purposes.

Zimocca. Also taken in the eastern Mediterranean, the zimocca sponges are the darkest and harshest of the Mediterranean grades. They have small pores, narrow intervening ridges, and are very durable.

Honeycomb. This massive cake-shaped sponge is found all over the Mediterranean. Its uniform surface is covered with small, blunt fiber tufts. The best of the honeycombs are called *mandruka* sponges.

Elephant-ear. The fine, soft, durable elephant ear is taken in the eastern Mediterranean. It is shaped like a cup or a cap, with the outer surface covered by soft, fibrous tufts.

Center of American Sponge Fishing

The United States is the largest sponge user in the world. Most of its supply comes from Tarpon Springs, Fla., the world's largest center of sponge fishing. Out of Tarpon Springs go about 175 sponge boats, manned by some 600 captains, divers, hookers, and general helpers.

Sponges are obtained by hookers working from the surface or by divers working on the sea bottom. Hookers work over the sides of the boat, reaching with long hooks into waters up to 30 feet in depth. Divers go down as far as 150 feet. The boats stay out for months at a time until their holds are filled.

SPORE. The one-celled organism by which a flowerless plant makes a new plant is the spore. It takes the place of the seed in a flowering plant. Invisible except under a microscope, spores float in the air all about us. Some species come to rest on exposed foods, where they form molds and mildews. Others settle on plants and develop into destructive rusts and smuts. Ferns and mosses, liverworts, and mushrooms, all reproduce by means of spores. The water-dwelling algae are also spore-producing plants.

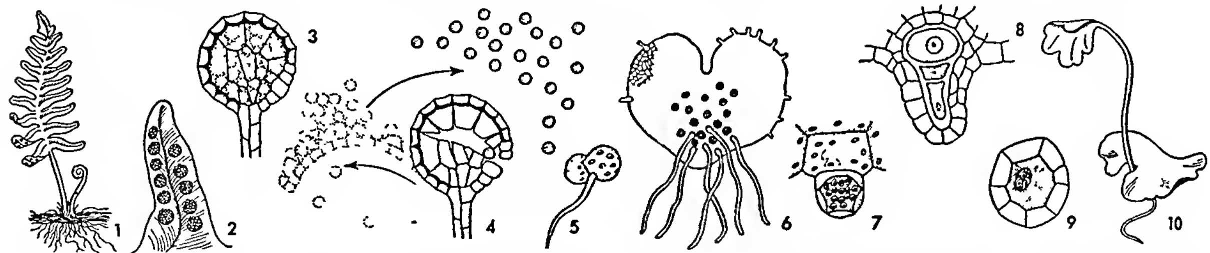
The plant carries its spores in cases called *sporangia* (singular, sporangium). You can find the cases on the underside of fern fronds, inside the gills beneath the mushroom cap, and in the lower surface of the bracket fungus. Mosses carry their spores in a capsule at the top of a stalk; horsetails in a cone at the top of the jointed stem.

The case opens and releases the spores when they are ripe. Finer than dust, they are scattered by the wind. The spores of water plants, such as the algae, swim by means of minute tails (*cilia*). They are called *zoospores;* their cases are *zoosporangia.* When the ripe case opens, the zoospores swim away. Soon they come to rest, lose their cilia, and grow into new plants.

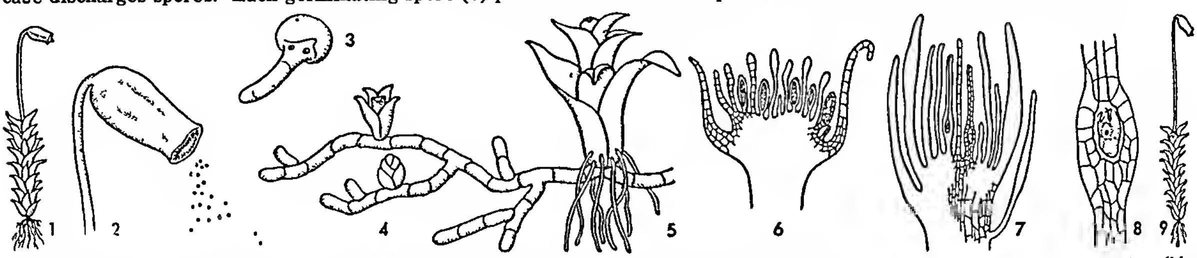
Some spores reproduce by simple cell division, called asexual (without sex) reproduction. The fungi are asexual. Their spores begin to grow by pushing out a *germ tube* through a thin place in the cell wall. The germ tube branches into a mass of threads called the *mycelium.* The mycelium absorbs food directly through its cell walls from the vegetable matter on which it is growing. It is the mycelium of rusts and smuts that injures the host plants. The new spore-bearing plant grows out of the mycelium.

Other spores are specialized male and female cells known as *gametes.* In order to start a new plant, two

ASEXUAL AND SEXUAL GENERATIONS IN FERNS AND MOSS



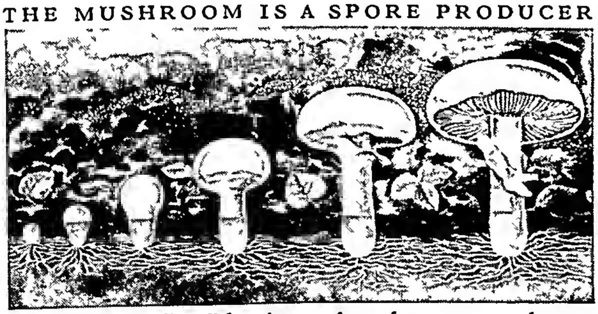
These pictures show the reproduction cycle in ferns. The fern (1) we see is the asexual generation. It bears spores and is called a *sporophyte*. The underside of a leaflet (2) shows the spore cases, where spores grow. (3) This highly magnified view of a spore case (*sporangium*) shows the spores. A ripe spore (4) case discharges spores. Each germinating spore (5) produces a prothallus (6), called a *gametophyte*. Little pockets on the lower surface bear sex cells, or gametes. The male pocket (*antheridium*, 7) produces sperm cells, and the female pocket (*archegonium*, 8) produces eggs. A sperm fertilizes an egg, forming a *zygote* (9). This completes the sexual cycle. The zygote develops from the prothallus into a new spore-bearing fern (10).



Moss plants also have alternating sexual and asexual generations like ferns. But mosses differ in one respect. Among ferns, the asexual generation of sporophytes provides the plants we see. With mosses, we see the sexual generation of gametophytes. The cycle of events and the structures are as follows: (1) a sporophyte with spore case on top of the stem; (2) enlarged view of a spore case; (3) germinating spore; (4) threadlike protonema which develops from a spore and produces leafy, visible moss plants (gametophytes, 5); (6 and 7) sperm-bearing antheridia and egg-bearing archegonia, which grow from the leafy gametophyte; (8) a fertilized egg (zygote); (9) a new stem and spore case (sporophyte) growing from the fertilized egg.

gametes must join to form a fertilized egg, called the *zygote*. Some plants produce asexual spores in one generation and sexual spores in the next. This cycle is known as *alternation of generations*. The asexual spores develop on a plant called the *sporophyte*. They grow into another plant, called the *gametophyte*, which bears the sex cells. The sex cells lie in pockets—the

THE MUSHROOM IS A SPORE PRODUCER



The mushroom, like all fungi, reproduces from an asexual spore. The spore sends out rootlike threads called mycelium, which absorb food from the soil. Out of the mycelium grows the familiar mushroom. It first appears above ground as a button. In the gills under the cap the new spores are produced.

antheridium, which contains sperms, and the *archegonium*, which contains eggs. In the moisture that collects on the plant, the sperm swims out of its pocket and into the archegonium, where it fertilizes the egg. From this egg the new sporophyte grows. (*See also* Algae; Fungi; Liverwort; Mildews and Molds; Mushrooms; Rusts and Smuts.)

SPOT. This small fish of the Atlantic Ocean is caught principally off the coast of North Carolina and Virginia. It has become a popular food fish in recent years, and the catch now averages 10 to 15 million pounds annually. Like its relatives, the croakers, drums, and sea trouts, it is able to drum on its air bladder. This organ is thin walled, however, and the drumming muscles are not well developed. Hence the sound is not as pronounced as the throbbing hum of the croakers. The fish that appear on the market are 6 to 12 inches long and weigh up to three quarters of a pound. The scientific name is *Leiostomus xanthurus*.

SPRAYING AND FUMIGATING. Among the best weapons against insects, molds, and bacteria that destroy crops or plague households are poisonous sprays, powders, or gases. The sprays and powders may be spread upon the threatened crops or upon the pests themselves. When these weapons are used against insects, they are called *insecticides*. Preparations that destroy fungus growths are called *fungicides;* and those that kill bacteria are *bactericides*.

If the insects belong to the group which chews or bites off portions of the plant, as do the worms and beetles, they may be destroyed by poisoning the surface of the plant with solutions such as Paris green, white hellebore, and London purple. If they suck the sap or plant juices, as do the plant lice, scale insects, plant bugs, thrips, and leaf hoppers, they are destroyed by caustic solutions, such as the kerosene emulsions, soap washes, lime and sulfur, and tobacco sprays. These burn the bodies of the insects and suffocate them by closing their breathing tubes, or spiracles. Poisons may be applied as powders dusted over the leaves by use of a bellows, but more often they are mixed with water and applied in liquid form. The solution may be sprinkled on with a whisk broom or by syringes; but power spraying machines are

INSECTICIDES AND FUNGICIDES

Many insecticides and fungicides need different preparations for special uses. Directions must be followed. Many are poisonous. Handle carefully!

Sprays or Solutions		Dusts	
Aldrin*	Gasoline*	Benzene hexachloride*	Pyrethrum*
Bichloride of mercury*	Kerosene*	Borax*	Rotenone‡
Bordeaux mixture†	Lead arsenate*	Calcium arsenate‡	Semesan†
Calcium arsenate*	Lindane*	Chlordane*	Sodium fluoride*
Carbolic acid*	Methoxychlor*	Copper dusts of various kinds†	Spergon†
Carbon bisulfide*	Nicotine sulfate*	Cryolite‡	Toxaphene*
Chlordane*	NMRI 448*	DDT*	**Poisoned Baits§**
Copper carbonate‡	Paris green*	Hydrated lime*	Borax*
Creoline*	Pyrethrum*	Lime†	Calcium arsenate*
Cryolite*	Rotenone‡	Naphthalene*	Cryolite*
DDT*	Soap*	Nicotine sulfate*	Paris green*
Dieldrin*	SR-406†	Paradichlorobenzene*	Sodium fluoride*
Ethylene-dichloride-carbon-tetrachloride*	Sulfur*	Parathion*	Sodium fluosilicate*
	Tartar emetic*	Paris green*	Tartar emetic*
	Toxaphene*		

*Insecticide. †Fungicide. ‡Both insecticide and fungicide. §Use alone or in various mixtures of active agents with bran or corn meal and moistened with water.

now used in large orchards and vineyards, and hand sprayers in gardens and small orchards. It is important that the material be applied evenly to prevent injury to the leaves of the plant and over as much surface as possible to do the most harm to insects.

The fungicides also may be either dusted or sprayed upon the infected plants. The one most used is called "Bordeaux mixture," named from the accidental discovery of its usefulness in Bordeaux, France, in 1882. Fungicides destroy the delicate tissues of the fungus growth without injury to the "host," as the plant upon which the pests feed is technically called.

Extensive crops and orchards are sometimes dusted by low-flying airplanes and helicopters that scatter the poisonous powders with the air currents from their blades. When only a few trees are infected, the disease is often checked by covering them with tents or bags which are then filled with hydrocyanic acid vapors. This does no harm to the tree or its fruit.

Killing Insects That Plague Man

For killing the flies and mosquitoes that get into houses, special sprays have been developed from kerosene, containing chemicals such as methyl salicylate. These chemicals attack the *chitin,* which forms the skin or shell of all insects (*see* Insects).

To get rid of insects that hide in cracks and walls—cockroaches, clothes moths, bedbugs, and the like—it may be necessary to fumigate the premises with various deadly gases, including hydrocyanic acid, gas mixtures containing carbon tetrachloride, and a few others. People and pets must leave during the fumigation, and because of the danger involved these operations should be undertaken only by professionals. Cities usually require that a permit for fumigation be issued and that signs be posted warning people against entering the premises until they are aired out. (*See also* Antiseptics; Agriculture; Ecology; Fungi; Gardens and Gardening; Insects; Scale Insects.)

Spring. When ground water (water which has sunk beneath the ground) issues from under the surface through a natural opening in sufficient quantity to make a distinct current, it is called a spring. In general, springs are due to the accumulation of water underground in porous rock or soil. Outlets may occur in a valley or upon a hillside. In a valley, they occur where the land dips below the level of the ground water; and on a hillside, where the water runs along the slope of a bed of rock or clay to a place where the bed "outcrops" or comes to the surface. Should the water be caught under an impervious layer of rock or soil, it will be under pressure. If then it finds an opening it spurts out as an *artesian* spring. If the opening is man-made, it is called an artesian well (*see* Artesian Well). Permanent springs are usually those that rise from a great depth. Many springs are intermittent. Springs of very great flow may indicate the existence of subterranean rivers.

Some hot springs are found near volcanoes. The water of those at great depths, warmed by subterranean hot rocks, is forced by steam pressure to the surface. A hot spring which throws out columns of water and steam is called a geyser (*see* Geyser).

Many springs, both hot and cold, contain large quantities of mineral salts in solution. These often become health resorts and fashionable "watering places," such as Spa, in Belgium (where the use of the name "spa" originated). Others are Karlsbad and Marienbad, in Czechoslovakia; Baden-Baden, in Germany; Bath, England; Hot Springs, Ark.; Saratoga Springs, N. Y.; Hot Springs, Va.; French Lick, Ind.; and White Sulphur Springs, W. Va.

Springfield, Ill. The capital of Illinois will always be a place of pilgrimage for admirers of Abraham Lincoln. Here he lived during the 25 years preceding his election as president, and here, in a beautiful mausoleum in Oak Ridge Cemetery, his body is entombed. The house in which he lived and his tomb are the property of the state. In the old Statehouse, now the Sangamon County Courthouse, he served as legislator and argued cases before the supreme court. His famous "house divided" speech was made in the present circuit court room. About 18 miles northwest is the restored village of New Salem, where he lived for six years before coming to Springfield.

The city is almost in the center of the state, near the Sangamon River. It is the trading center of a

farming and coal-mining region, and manufactures tractors, electric meters, electronic devices, boilers, hydraulic equipment, metal specialties, clay products, mattresses, shoes, stock feeds, and cereal products.

On a nine-acre plaza stands the Capitol, the State Armory, and the Supreme Court, Archives, Office, and Centennial buildings. Lake Springfield is the source of water supply and a recreational area. On its shores are the Lincoln Memorial Garden and a fine residential district. The artistic Vachel Lindsay Bridge is a memorial to the Springfield poet.

Springfield was settled in 1819 and became the state capital in 1837. It is governed by a commission. Population (1950 census), 81,628.

SPRINGFIELD, MASS. Two travelers, an Englishman and an American, were looking out over the Rhine Valley from the tower of the Strasbourg cathedral. "Have you ever seen anything more beautiful?" exclaimed the American. "Only once," said the Englishman, "from the tower in Springfield, Massachusetts." "Why," said the amazed American, "I live in Springfield, but I have never seen that view."

A campanile tower 300 feet high commands this view. The tower is flanked on either side by an auditorium and an administration building, all making up the Municipal Group (*see* City). Several cultural institutions are grouped about a large court farther east. Here are the City Library; the Museum of Natural History; the Museum of Fine Arts; the George Walter Vincent Smith Art Museum; and the William Pynchon Memorial Building, the home of the Connecticut Valley Historical Museum. The library and museums comprise the City Library Association. In Merrick Park is Saint-Gaudens' statue, 'The Puritan'. The Church of the Unity and the County Courthouse were designed by H. H. Richardson. Springfield is the seat of the International Y.M.C.A. College and the American International College.

Springfield has made firearms since the United States Arsenal was established here during the Revolution. The city also makes machine tools, machinery, valves, chemicals, rubber goods, electrical equipment, motorcycles, sporting goods, and toys. Many insurance companies have headquarters here.

Under the leadership of William Pynchon, Springfield was first settled in 1636. In 1675, during King Philip's War, it was burned by the Indians. Riots occurred during Shays' Rebellion, 1786–87. The *Springfield Republican*, one of New England's leading newspapers, was established in 1824. Webster's Dictionary has been published here since 1847. The city is governed by a mayor and council. Population (1950 census), 162,399.

SPRUCE. The home of the spruces is from the Arctic Circle south to the Himalayas of Asia, the Pyrenees of Europe, and the Appalachians and the Rockies of North America. These cone-bearing evergreen trees,

A SPRUCE AND ITS DISTINGUISHING MARKS

Like the other spruces, the red spruce above has needles that grow singly all around the branches, not in clusters, like the pines. You can tell a spruce from a fir by its sharp, stiff, four-sided needles. Fir leaves are blunt, soft, and flat. Spruce cones hang down; fir cones stand erect.

of which there are about 40 species, make up the genus *Picea* of the pine family. In stands, the trunks are usually clear of branches for about 50 feet and have conical crowns. Growing singly, they are generally shaped like a pyramid, the lower branches often touching the ground, the upper ones tapering up to a point.

The species vary considerably in size. Some are small or medium-sized trees from about 50 to 100 feet high; others soar to more than 200 feet. Spruces grow best in moderately moist, sandy soil, with some protection from the sun. They are long-lived trees. In favorable locations some live for more than 400 years.

Because of their symmetry and thick foliage, spruces are valued for ornament. For planting in parks and gardens they are sometimes dwarfed by pruning. They are used for windbreaks and make excellent hedges, being dense and durable if trimmed regularly.

The most important of the North American species are the white spruce, the black spruce, the red spruce, the blue, or Colorado spruce, the Engelmann spruce, and the Sitka spruce. The last three are found chiefly in the western part of the United States and Canada.

The finest European species is the Norway spruce, which is planted in North America as an ornamental tree. From Norway and Sweden, where it is most abundant, the lumber is shipped throughout Europe.

Commercially, spruce wood is very valuable. It is unusually light for its strength, easy to work, and has a high degree of elasticity. It is the chief wood from which paper pulp and rayon are manufactured. In shipbuilding, masts and spars are made of it. It is also used for boxes and crates, general building purposes, and parts of airplanes. Because of its resonant quality, it is the finest wood for the sounding boards of musical instruments.

SQUASH. Squashes, pumpkins, and gourds belong to one big puzzling family. Gourds, with their white blossoms and hard inedible fruit, are easily identified; but pumpkins and squashes, cultivated so extensively for the thick-fleshed edible meat, have become badly confused. (*See also* Pumpkin.)

Liberty H. Bailey, in his 'Lessons with Plants', tells how we can distinguish between a pumpkin and a squash by a glance at the stem. If the stem is ridged and furrowed or if it flares at the point where it joins, the fruit is a pumpkin; but if it is soft, spongy, and cylindrical, not enlarged at the junction, it is the stem of a squash. You will find by applying this classification that many fruits you have always known as pumpkins are really squashes, and many you have called squashes are pumpkins.

If the name squash belongs to one group more than another it is to *Cucurbita maxima*, to which species belong the Hubbard, Marblehead, Sibley, and turban squashes. The field, or common pie, pumpkin is *Cucurbita pepo*. The vegetable marrow, so highly prized in England, and also the summer squashes—the scallop, pattypan, and some crookneck types—are all varieties of the pumpkin species. On the other hand, the cushaws, Canada crooknecks, Japanese crooknecks, dunkards, and sweet potato squashes belong to still another species (*Cucurbita moschata*) and are probably native to Asia. In England all varieties of pumpkins, squashes, and gourds are often called "gourds." (*See also* Gourds.)

ONE OF THE SUMMER SQUASHES

One of the summer squashes is the vegetable marrow. It is tender and mild flavored. The whole vegetable is eaten, including rind and seeds. It is cut up and fried or steamed and mashed with butter.

SQUID. This mollusk of the cuttlefish family has ten arms, or tentacles, bearing suckers, and a vicious, parrotlike beak. Usually squid are small, and they are much used for bait by North Atlantic fishermen. The giant squid, which is the "devilfish" of fiction, sometimes attains a length of 55 feet and a weight of 1,000 pounds. An observer on a whaling ship describes a deadly conflict which he witnessed between a large sperm whale and a giant squid. The whale appeared to have the tail part of the squid in its jaws and to be sawing through it in a businesslike methodical way. The tentacles of the squid seemed to enlace the whale's whole body. The latter's head, especially, seemed a network of writhing arms. The black eyes of the squid, which contrasted with the livid white head, were at least a foot in diameter. (*See also* Octopus.)

Familiar WILD ANIMALS *of* CITY *and* FOREST

SQUIRREL. No wild animal is better known than this lively little creature. It is now as common in city parks and gardens as in its native forests. Laws have been passed to protect it, and as a result squirrels have become very tame.

When you first approach it, the squirrel will leap for the nearest tree trunk, then turn and study you with bright black eyes, lashing its bushy tail furiously and scolding you in a husky bark. You can usually coax it up to you by holding

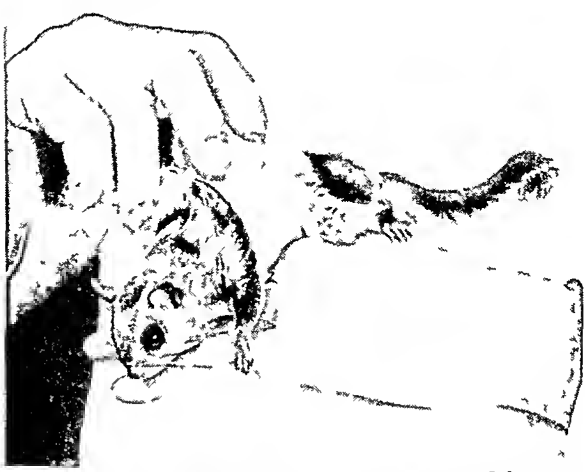
The gray squirrel is common in parks, gardens, and woods throughout North America. It is easily tamed, but beware of those sharp teeth.

THE DAINTY LITTLE FLYING SQUIRREL

Gliding membrane outspread, feathery, flat tail brought forward, and rear legs extended backward, the flying squirrel is about to land. A forepaw shows at the right corner of the "wing."

This is an upper view of a flying squirrel. The broad, flat tail acts as a rudder and brake. The membrane connects the front and rear legs. It lies against the body when not in use

The mother flying squirrel is holding a baby in her mouth. She grasps it by the loose skin of the stomach. The baby holds onto the mother by wrapping its legs around her neck.



This picture gives an idea of the small size of the flying squirrel. It is about 9 inches long, including the 4-inch tail Notice the large eyes, indicating that it is a nocturnal animal

out a nut. When it comes to trust you, it will sit up on its haunches before you, turning the nut with handlike front paws and nibbling through the shell.

The different kinds of tree squirrels differ only in size and color. All have strong, muscular bodies, sharp, well-curved claws, large eyes and ears, and a long, plumy, flattened tail which helps to balance them in their leaps through the trees. They are tempting food for meat-eating animals and for birds of prey, and their enemies are many. Most squirrels are active during the day and sleep at night.

Nests and Food

Squirrels build nests of tightly woven sticks and leaves, lined with finely shredded inner bark. The nest may be placed high in the crotch of a tree or inside a hole in the trunk. In the northern part of their range the squirrels prefer the open nests in the summer and tree-hole nests in the winter.

Until their favorite food of acorns and other nuts ripens, they feed on the buds and young leaves of trees, on seeds, berries, mushrooms, and some insects. In the fall they bury a store of nuts to use in the winter months to come. They probably recover them by recognizing the disturbed ground or by sense of smell. Many nuts are never recovered. Squirrels are an important factor in reforestation. Nuts planted far from the parent tree under favorable conditions sprout and produce new trees (*see* Nature Study).

Squirrels do not hibernate. During severe weather, however, they remain in their nests, the thick tail wrapped around them like a shawl. Eastern gray squirrels sometimes migrate in great numbers It is believed that increase of population and shortage of food cause them to move blindly to the South and West. Thousands lose their lives when they attempt to swim over wide rivers and cross busy highways.

The Eastern Gray Squirrel

The eastern gray squirrel is the familiar species of parks and city streets. It ranges from southern Canada to Florida and west to the Great Plains. It averages 18 inches in length, including the 9-inch tail, and weighs $1\frac{1}{2}$ pounds. The color of the fur changes with the seasons from a dark, rust-tinged gray in summer to a light silvery gray in winter.

Gray squirrels raise two families each year. The first is born in early spring, usually in March, and the second in July. The two to four young are born 54 days after mating. They are naked, blind, and helpless. The mother nurses them for six to eight weeks. Then they begin to venture out of the nest for their first solid food of buds, flowers, and leaves. They reach full growth in about a year.

Western gray squirrels keep more to the oak and evergreen forests. A close relative is the Kaibab squirrel, found only on the north side of the Grand Canyon. It has heavily tufted black ears, dark gray upper parts, black under parts, and a white tail.

Red Squirrels, or Chickarees

Red squirrels, often called *chickarees*, are abundant in the forests of North America from coast to coast. They are smaller than the grays, averaging 12 inches in length, including the $4\frac{1}{2}$-inch tail, and weigh about half a pound. They are lively, noisy, and quarrelsome, and in the eastern part of their range usually drive away their big rivals. They feed on pine cones and have the bad habit of robbing birds' nests of eggs and young. They raise only one litter of four or five young, born in late spring. The Douglas squirrel, found west of the Rocky Mountains, is a relative of the red squirrel.

Fox squirrels are the largest—20 to 27 inches long, including a 12-inch tail. They weigh about two pounds. They are rusty to blackish in color. They raise only one family of two to four young. Fox squirrels range throughout the United States.

Flying squirrels are widely distributed throughout the Northern Hemisphere. They are little known because, unlike the other squirrels, they move about at night, becoming active only at dusk. The flying squirrel has a flap of loose skin connecting the fore and hind legs. When the legs are extended the flap stretches to form a parachute. Thus the animal can glide from higher to lower branches in trees. The eastern species is only 9 inches long, including the 4-inch tail. It has dense, silky fur, slaty gray at the base, the tips varying from gray to pinkish cinnamon. One family of three to six young is raised each year. A larger arctic species inhabits the western mountains and the forests of northern Canada.

The skins of the Russian gray squirrel are used for fur coats. The Canadian red squirrel is trapped in large numbers and the fur used for trimmings.

Squirrels as Pets

Baby squirrels sometimes tumble out of their nests and are found lying helpless on the ground. They make attractive pets. If the infant is still blind and toothless it should be fed warm milk, diluted with one part water to three parts milk. A medicine dropper is the best feeder. As the baby grows older it may take whole milk, vitamins, and some semisolid food such as pablum. Later it will relish lettuce, raw vegetables, cooked ground meat, and nuts. Squirrels should not be fed peanuts exclusively.

The babies also need a warm bed, such as a carton lined with soft rags. At first the bed should be heated. Most convenient is an electric light bulb, so placed that the animal cannot be burned by it.

Some member of the squirrel family (*Sciuridae*) may be found in almost every part of the world except Australia. The family belongs to the order of rodents (*Rodentia*), or gnawing animals. It falls into two divisions—ground squirrels and tree squirrels. The ground squirrels include the groundhog, or woodchuck, the prairie dog, the gopher, and the chipmunk, which are described in separate articles. The scientific name of the eastern gray squirrel is *Sciurus carolinensis;* of western gray squirrel, *S. griseus;* of Kaibab squirrel, *S. kaibabensis;* of red squirrel, *S. hudsonicus;* of Douglas squirrel, *S. douglasii;* of fox squirrel, *S. niger;* of flying squirrel, *Glaucomys volans;* of arctic group of flying squirrels, *G. sabrinus.*

BABY GRAY SQUIRRELS

These four baby gray squirrels are so young that their eyes are not yet open, but they are able to cling to the side of a tree at birth. They were removed from the nest to make this picture.

STALIN—
Soviet RUSSIA'S
"Man of Steel"


To symbolize his complete power, Stalin ordered mass displays of his portrait

STALIN, JOSEPH (1879-1953). The man who schemed and slaughtered to become the dictator of Soviet Russia was Joseph Stalin. His true name was Iosif Vissarionovich Dzhugashvili. In 1912 he took the alias of "Stalin"—from *stal*, which in Russian means "steel." Sixteen years later, in 1928, he became absolute dictator of mighty Soviet Russia. Soon after the second World War he controlled most of Eastern Europe, pushed his dread influence into Asia, and brought the fear of Communism to all the free nations of the world.

A Revolutionary Born in Near-Poverty

Stalin was born in Gori, a village in Transcaucasian Georgia, Dec. 21, 1879. His father, Vissarion Dzhugashvili, a cobbler, was drunken and cruel. To help support the family, Stalin's mother took in sewing and washing. When Stalin was 14 years old, his father died. Young Stalin—swarthy, thick shouldered, and pock marked—was sent to the Orthodox Russian seminary at Tiflis to be educated for the priesthood.

He soon turned from theology to interest in Communism and, at 15, was already planning how to overthrow the czar, ruler of Russia. The seminary disciplined him time and again. Finally, when he was 20 years old, he was expelled as an agitator.

He remained in Tiflis, working briefly at one job after another. As he had no training for farming, business, or a trade, he soon gave up trying for a steady job. Instead, he began to work for Communism and joined the Tiflis branch of the Marxist Social Democratic Organization.

Stalin then became a professional revolutionist, striving to incite revolt against the government of the czar. He edited illegal pamphlets and helped to distribute them secretly Frequently he organized strikes among the factory workers in Tiflis. His ability to organize won the attention of party leaders, and they sent him to form a Communist organization in Batumi, a large port on the Black Sea.

His revolutionist activities brought his first arrest in 1902. He was exiled to Siberia in 1903 but soon escaped. In fact from 1902 to 1913 Stalin was arrested five times, exiled five times, escaped four times, and released once. Like his fellow revolutionaries, Stalin adopted one alias after another in order

FROM FANATICAL YOUNG REVOLUTIONARY TO FANATICAL DESPOT

This 1910 card is part of the record the czar's police kept on Stalin Right, is one of the last portraits (taken 1951) of him as dictator of Soviet Russia. After his death his successors removed his pictures in an effort to kill faith in "one man" rule

to evade arrest. He first called himself Koba, after a legendary Georgian hero; later he changed to David, Soso, Chiijikov, Nijeradze, and, finally, Stalin.

Stalin Joins the Bolshevists

In 1903 the Social Democratic Organization split. One faction, headed by Nikolai Lenin, called itself Bolshevik (*see* Lenin). The other faction, opposed to Lenin's creed of violence, was Menshevik. Stalin believed in Lenin's policy, and so joined the Bolshevists. He became a party leader in his native Transcaucasia. In 1905 he attended a secret Bolshevist meeting in Finland; in 1906, in Stockholm; and the following year in London.

At these meetings Stalin's iron zeal and organizing ability won Lenin's high regard. Shrewd Lenin worked with Stalin closely. In 1912 Lenin made him a member of the Central Committee. Meanwhile Stalin wrote for the Bolshevist newspaper *Pravda* (Truth), which he is said to have founded. Arrested again in 1912, he again escaped within a few months. Going to St. Petersburg (now Leningrad), Stalin organized a Bolshevik group in the Duma, the parliament of czaristic Russia.

In 1913 Stalin was arrested for the fifth time. Exiled to the grim Turukhansk region of Siberia, above the Arctic Circle, for the first time he failed to escape. But in March 1917 the revolution led by Alexander Kerensky freed all political prisoners, and Stalin returned to St. Petersburg.

There he helped Lenin to prepare final plans for the history-making Bolshevist revolution. Stalin's name seldom appears in records of the revolution, for he remained in the background as an administrator. His work was largely responsible for the success of the bloody October Revolution of 1917. (*See also* Russia.)

FROM VILLAGE OBSCURITY TO WORLD FAME

1. The timber and adobe house where Stalin was born in the village of Gori in Russian Georgia. 2. At ten Stalin was a brooding schoolboy in Gori. 3. An official Soviet Russia painting shows Stalin as a bearded young revolutionist. Pamphlet in hand, he harangues his fellow Marxist Communists. In the background, two of his followers keep a look-out. 4. Stalin, left, meets his chief, Nikolai Lenin, center, and Kalinin, later president of the U.S.S.R.

During the civil war that followed the revolution Stalin served as political commissar with Bolshevist armies on several fronts. At that time political commissars were entrusted with military duties, and Stalin showed exceptional ability as strategist and tactician. In 1918 he directed the successful defense of vital Tsaritsyn against the insurgent White army. (In the second World War this same city, renamed Stalingrad, broke the drive of a German army.) Through 1919-20 Stalin served on the Leningrad and Polish fronts. In 1921 his forces invaded Georgia, drove out the newly independent government, and seized his homeland for the Bolshevists.

But the next year marked the real start of Stalin's grasp at political power, for he became general secretary of the Central Committee of the Communist party. Russians whispered, "Lenin trusts only Stalin. Stalin trusts no one." As Lenin's trusted aide. Stalin methodically assumed increasing power. Grimly he undermined Leon Trotzky, war minister and Lenin's former close associate (*see* Trotzky).

Some of Stalin's unscrupulous methods worried even Lenin, the merciless revolutionary. Lenin wrote, "Stalin is too rough." But Stalin was undisturbed by criticism. In 1925, a year after Lenin's death, Stalin forced Trotzky to resign as war minister, and expelled him from the party in 1927. Determined to eliminate the minority "Trotzkyite" influence, Stalin exiled Trotzky in 1928.

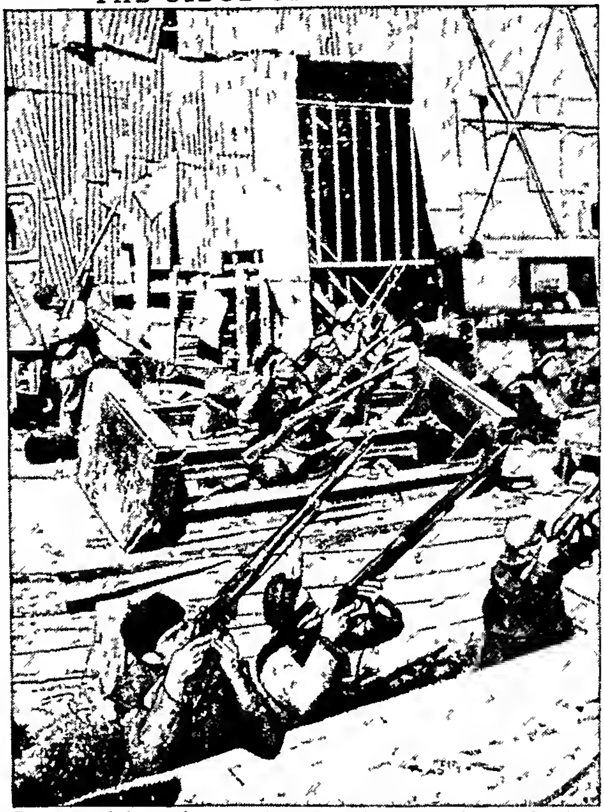
Stalin, the "man of steel," was then supreme ruler of Soviet Russia. In a relentless drive to industrialize and modernize Russia, he launched the first in a series of Five-Year plans. He declared, "We are 50 to 100 years behind advanced countries. We must cover this distance in 10 years." Later, to speed the effort, he exhorted, "To slacken the tempo means to

fall behind. And the backward are always beaten."

Stalin ordered the collectivization of farms. When peasants resisted, Stalin ordered the state to seize their land and possessions. Well-to-do farmers, called *kulaks*, especially resented collectivization. Determined to root out all opposition, Stalin showed no mercy to the rebellious kulaks. In 1932-33 he forced a famine on the Ukraine, and "liquidated" some 3,000,000 kulaks through death by starvation.

In 1936 Stalin's ruthless methods again drew world attention. To consolidate his place as supreme dictator, he conducted a series of "purges." Claiming that a number of Red army officers and scores of Old Bolshevists were "plotting against the state," Stalin had them executed. Many of them were men who had helped Stalin drive to power.

THE SIEGE OF STALINGRAD



Summoned from their machines, workers crouch outside their battered factory to fire at diving German planes. Such scenes occurred daily during the siege. The devotion of workers like these helped the Red army to hold the great city.

In 1939 Stalin startled the world again when he brought Russia into a nonaggression pact with Nazi Germany. One month later complacent Germany invaded Poland, starting the second World War. The nonaggression pact permitted Russia in 1940 to seize eastern Poland, attack Finland, and absorb Bessarabia and Bucovina without German opposition. This strategic opportunism of Stalin's extended Russia's borders into outlying buffer areas.

In May 1941 Stalin made himself premier, replacing Molotov (*see* Molotov). The next month Russia was invaded by Germany. Stalin at once took over-all command of the Red armies and directed reorganization of Russian industry. He also dictated every move in Russia's foreign relations. In 1943 at Tehran and early in 1945 at Yalta, he issued inflexible terms to his Allies—Premier Churchill of Great Britain and President Franklin Roosevelt of the United States. Later in 1945 he made a Potsdam pact with President Truman on the reconstruction of defeated Germany, then defiantly broke the terms of the accord. (*See also* World War, Second, section on peace.)

Immediately after the war's end, it became apparent that Stalin was determined to achieve a twofold aim —to make Russia dominant in Europe and to impose Communism on the world. Through purges and other relentless measures he forced Communist governments on eastern Europe and sought to gain control of Italy and France. In the United Nations and in Allied councils, his obstructionist policy blocked efforts to establish world peace (*see* United Nations). His blockade of Berlin long filled the world with fear of a third World War (*see* Europe; Germany).

Personal Life Secretive

No modern leader kept his personal life so secretive as Stalin. Many of the year-dates and facts of his life remain uncertain. He was married in 1903, at the age of 24, to Ekaterina Svanidze, a native of Georgia. She died in 1907 of tuberculosis. Their son Yasha (Jacob) then lived with his mother's relatives. In 1919 Stalin married Nadya Allilueva. Their children were a daughter Svetlana and a son Vassili, who served in the Red air force during the second World War. Nadya died under unexplained circumstances in 1932 after, according to some reports, protesting Stalin's pitiless "liquidation" of the kulaks. Strangely, at times he had great personal charm.

To symbolize his powerful, unifying hold on Communist peoples, Stalin spread his pictures over Russia and satellite nations. His death on March 5, 1953, found no single person powerful enough to succeed him as dictator. His position as premier was taken by Georgi Malenkov, but control of the government passed to a Presidium, a new five-member committee headed by Malenkov as chairman (*see* Russia).

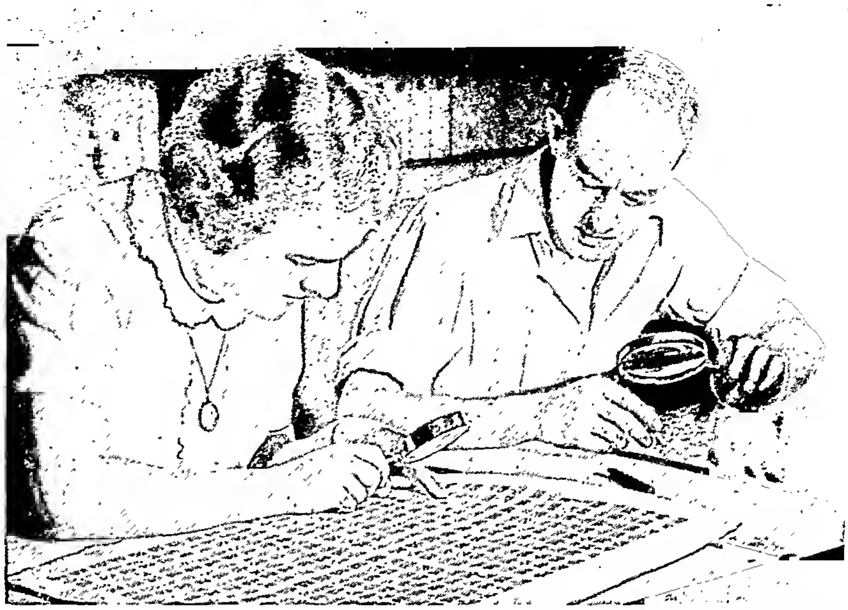
STALINGRAD. After the Soviets came to power in Russia, Stalingrad was changed from a dusty market town into a mighty industrial city. Standing on the lower Volga River, it was the center of a rich farming region. The Soviet government built a canal from the Don River, about 50 miles west, to bring coal and iron from the Donets basin.

Stalingrad grew up on the site of a fort called Tsaritsyn, built in 1589 to hold back marauding nomads. In the Revolution of 1917 it was seized by the Bolsheviks. The Bolshevik leader was Joseph Stalin, later dictator of Russia, and in 1925 Tsaritsyn was renamed Stalingrad for him. In the second World War the Red army halted the German drive across Russia at Stalingrad (*see* World War, Second). This heroic defense turned the tide of the war. The city was shattered, but its residents returned to rebuild it. Population (1947 est.), 400,000.

Around the WORLD *with* POSTAGE STAMPS

STAMP AND STAMP COLLECTING. Many people see postage stamps every day without realizing how big a job the stamps do. And many people never realize what fun these bits of paper can provide. But stamp collectors find them fascinating. In their collections they can travel throughout the world or go back into history.

The phrase *postage stamp* has an exciting meaning. In the old days, when men relayed letters and packages across country, the *posts* were stations where one messenger handed mail on to the next. The *postage* was the charge for this carrying. The word *stamp* comes from the fact that letters were sealed with a blob of wax. Before the wax hardened, the design of a ring or seal was stamped into it so as to identify the sender of the letter.



At the Bureau of Printing and Engraving, where United States stamps are made, a proofreader checks a proof sheet for flaws while the man at her left notes the corrections on the plate. They work under a strong fluorescent lamp.

Modern stamps came into use in 1840, when Great Britain began using small adhesive labels. Stamp collecting began almost immediately. Soon the word *philately* was invented to describe the collecting and study of stamps. Philately comes from two Greek words. They mean together "the love of tax-free things." This describes stamps, which are receipts showing that the sender has paid the money needed to carry the letters and packages.

How Stamps Are Made

Before anyone starts collecting, he should know how stamps are made and how they travel through the mails. The manufacturing process affects all stamps. And many desirable features of used stamps depend on what happens to them in the mails.

Most modern stamps carry a picture on the face, or *obverse*. A designer first draws the picture and the frame, complete to the smallest detail. Then one of several processes is used to get the design ready for printing. The oldest process, still widely used, is engraving. Other popular methods are typography and lithography (*see* Photoengraving and Photolithography). Some early stamps were printed directly from hand-set type when other methods were unavailable.

A collector who knows how a stamp was prepared for printing can often distinguish two stamps that may otherwise seem the same. An engraved stamp has lines raised a little above the surface. In typography the lines are slightly pressed into the paper. Sometimes the lines show through on the back of the stamp. Engraving gives the sharpest and finest lines. Typography looks flat by comparison. In lithography, lines will be fuzzier and the whole surface duller.

Printing is done on the flat-bed press or the rotary press (*see* Printing). Since the early 1920's, United States stamps have been mostly printed on the faster rotary presses. Stamps printed on a rotary press are a little longer or wider than similar stamps printed on a flat-bed press. The plate is stretched slightly when it is curved to fit the press cylinder. Thus two stamps of the same design printed by the two kinds of presses have a slight difference in length or width. Rotary-press printing usually colors the white portion of the stamp slightly.

Varieties

Anything that makes a difference in stamps that otherwise look alike to an ordinary observer is important to the collector. He calls such different stamps varieties. Generally speaking, a major variety is one that is intended; a minor variety is one that results from an error. If a plate is slightly changed to improve the impression, stamps printed after the change will be a major variety.

Another major variety is a difference in paper. The two most common kinds of paper used in printing stamps are called *wove* and *laid*. The difference between some stamps can be told only in the kind of paper used. The United States uses only wove paper for its adhesive stamps, though stamped envelopes have been printed (embossed) on laid paper.

Either wove or laid paper may have watermarks worked into it when it is made. Watermarks on stamp paper are usually special designs used exclusively by the government issuing the stamp. The watermark may appear once on each stamp, or it may be spread across the whole sheet with only a part of the mark appearing on each stamp. Many countries still use watermarked paper, but the United States stopped using it in 1915. Sometimes the same design is printed on both watermarked and unwatermarked paper. Some British stamps printed from 1854 to 1924 can be told apart only by the different watermarks.

After being gummed, the sheets may have small holes called perforations punched between the rows of stamps. The presence or absence of perforations, and the number of perforations in a given distance on each stamp create other varieties for the collector. For example, a series of United States stamps printed from 1912 to 1921 comes with several different perforations.

Variations also appear in marking. An envelope that has gone through the mails has a series of straight or wavy lines marked across the stamp. Sometimes a slogan, such as "Use Air Mail," is used. This part of the cancellation is called the *killer.* The other part of the cancellation is a circle, called the *town circle,* enclosing the name of the city and state where the envelope started its trip, and the date and hour of postmarking. People who collect covers, as they call envelopes bearing canceled stamps, prize different and unusual cancellations.

Stamps with errors are scarce, and hence valuable to the collector. One famous error occurred in 1916. A plate with 400 red 2-cent stamps bearing a Washington portrait had three engravings badly worn. These were accidentally replaced with three 5-cent engravings bearing the identical portrait. As a result, the new sheets of what should have been 400 red 2-cent stamps had three red 5-cent stamps. When the error was discovered, the plate was corrected. But by then, some faulty sheets had been sold. These 5-cent errors are much sought after, and the stamp has a catalog value of from $50 to $1,250.

How to Start a Collection

Starting a stamp collection is simple. Discarded envelopes will furnish the first stamps. Or new stamps can be bought at a post office. Stamp dealers sell both used and unused stamps. In most cities dealers have stores where they sell stamps. Stamps can also be bought from dealers by mail.

Since 1921 the United States Post Office has maintained a Philatelic Agency in Washington for selling current stamps to collectors only. Stamps are sold in sheets, blocks of four, and occasionally in small souvenir sheets. Stamps may be bought on the first day of issue and afterwards. Some other countries and the Pan American Union also have philatelic agencies.

Collectors prize both the rarity and fine condition of their stamps. Only good luck or much money allows the collector to get a real rarity. But good condition, the second goal of a real collector, can be reached by a beginner. Anyone can look for stamps in the best possible condition. And with care and knowledge, he can keep them that way.

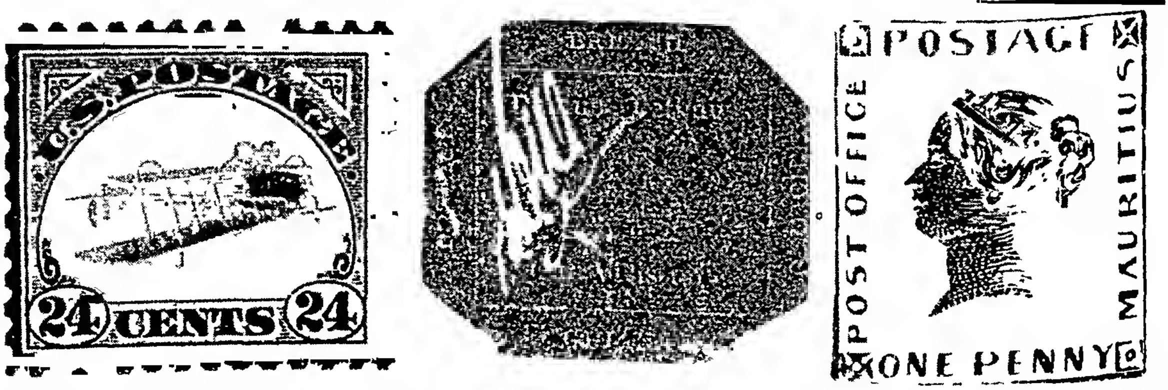
The best condition of a new stamp is described as *mint.* Such a stamp has all its original gum (abbreviated to "O. G." by collectors). New stamps that are well centered with even margins on each side and with all the perforations intact are most desirable. Used stamps should have no tears or creases, should have all the gum washed off the back, should have no thin spots or holes unless made by canceling. The lighter the cancellation on the stamp, the better.

Some stamps should never be removed from their covers. Generally, all stamps before 1900, stamps canceled in an unusual manner, and stamps canceled on the first day of issue should be kept on their covers. Any cover that shows it was sent by or to a famous person, or used in a historic situation should be kept intact. Unusual cancellations are those made on trains or ships, those made in a color different from the usual practise, those in which the killer has an unusual design, and those which show evidence of unusual postal service.

How to Remove Stamps

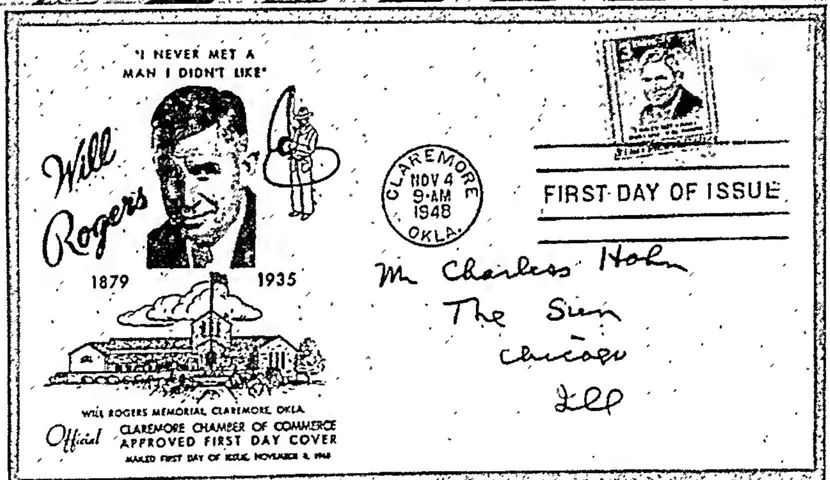
One good way to remove a stamp from an envelope is to tear off the corner with the stamp and soak it in clean warm water for about 15 minutes. But some stamps fade in water, and ink used in others dissolves. Some of these can be told by rubbing a silver coin over the face. If a black mark is left, do not soak it. A stamp catalog will also tell which stamps not to soak. If the stamp cannot stand soaking, float the paper on the water with the stamp up. When the paper under the stamp has been thoroughly soaked, the stamp can be peeled off.

THREE FAMOUS AND VALUABLE RARITIES



At the left is the inverted center 24-cent stamp of the 1918 air-mail series. Only one sheet of these errors ever reached the public. They are valued at $4 000 a stamp. In the center is the rarest stamp in the world. It is the British Guiana one-penny black, worth $50,000. At the right is the one-penny orange Mauritius stamp of 1847. It is inscribed "POST OFFICE" instead of "POSTPAID."

A "FIRST FLIGHT" AND A "FIRST-DAY" COVER



At the top is a cover that was carried on the first official flight of the Royal Dutch Air Lines route between Willemstad, Curaçao, and Miami, Fla., on Aug. 16, 1943. Bottom, a first-day cover honors the popular American, Will Rogers. The stamp is a Will Rogers commemorative issue, and the "killer" states "first day of issue."

Another method requires a metal box and two pieces of clean blotter. Soak one blotter and put it in the bottom of the box; place the piece of envelope on the wet blotter with the stamp up, and cover it with the dry blotter. When the paper has become soaked, the stamp can be removed. Whatever method is used, the detached stamp should be placed face down on a clean blotter to dry.

The Stamp Album

The usual way to keep stamps is in an album. The best album for the beginner is one that has sections for different countries, with squares printed where each stamp is to go, and with illustrations of each type of stamp. The experienced collector who wants to specialize uses a plain blank album. Both types of album come either bound or looseleaf.

No real collector ever handles stamps with his fingers. Even the cleanest hands have grease and moisture on them, and handling stamps makes them dirty. Instead he uses stamp *tongs*. These are like tweezers except that the holding surfaces are smooth. Many beginning collectors ruin stamps by pasting them in an album. The correct way to fix stamps in the album is with peelable hingers, narrow strips of transparent paper gummed on one side. If you get a stamp in better condition than one you have, you can remove the first stamp with tongs and pull off the hinge without damaging the gum or the back of the stamp.

Pictures and lettering on stamps are not very large. A small magnifying glass will help you see even the finest shaded lines and letters clearly. Another handy device is the perforation gauge. The gauge determines the perforation of a stamp by measuring the number of perforations in two centimeters. The gauge is a card with lines two centimeters long marked off with dots showing perforations from 7 to 16½. The stamp is placed along these lines until the dots exactly fit the perforations.

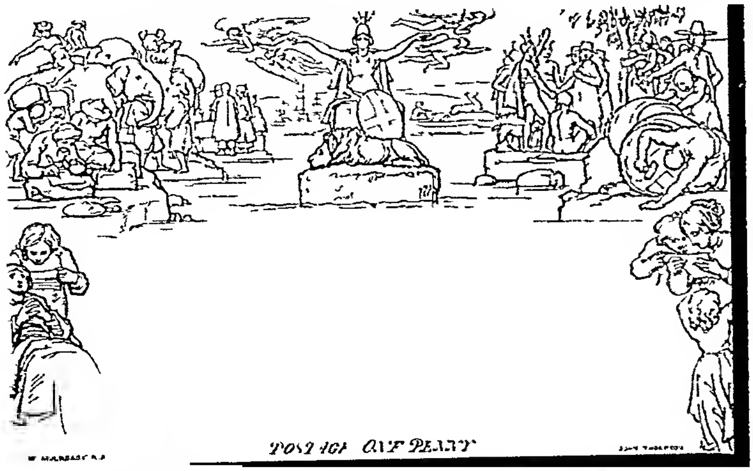
The most important source of information to the collector is the stamp catalogue. It contains complete descriptions of all stamps, arranged by country, illustrations of each type, and selling prices.

How to Buy Stamps

Advertisements in stamp magazines use such terms as *packet, set,* and *approval sheets.* Packets are envelopes containing a specified number of stamps. The stamps may be a mixture with some duplicates; they may be all different. They may be all from one country, or with pictures relating to one subject, such as animals or exploration. Buying a packet of all different stamps is a good way to start a collection.

A set of stamps may be determined by a number of things. All the stamps bearing the same design, but in different denominations constitute a set. So do a number of stamps with different designs but all having a common subject. Approval sheets are sheets with

THE FIRST POSTPAID ENVELOPE AND POSTAGE STAMPS



At left is the Mulready one-penny envelope sold by Great Britain in 1840. It was one of the first modern methods of paying for postage but was soon discarded. At the right are the world's first adhesive postage stamps, the two-pence blue and the penny black of Great Britain (1840). Below them are the first United States governmental issues, the 10-cent black and the 5-cent brown of 1847.

stamps on them. Dealers send them on request. The collector picks out what he wants and returns the unwanted stamps with payment for those he keeps.

Sooner or later, the collector decides to have either a general or a specialized collection. From a general collection, the beginner learns many strange and new things. But after awhile, the strange becomes familiar. Then is the time to specialize. You can specialize to suit your own interests. There are no rules. You can collect stamps of one country, of a continent, of one denomination, or of certain subjects such as animals or ships.

Kinds of Specialized Collections

The collector can hunt postage stamps that have particular uses. Some countries have air-mail, special-delivery, special-handling, and parcel-post stamps. In addition, there are stamps that are not postage stamps, such as revenue-tax, postal-savings, and war-savings stamps. Seals, such as Christmas seals, are issued by private institutions. Some countries issue semipostal stamps priced above their postage value, with the excess going to some charitable cause.

Countries sometimes overprint and surcharge stamps. Overprinting a stamp is done by printing on the stamp the name of some territory where the stamp was not formerly used or words to change its use. Surcharging changes the value of the stamp by printing a new one on it. Overprinting or surcharging creates an entirely new variety for stamp collectors.

Many collectors specialize in first-day covers The first-day post office for a new stamp will often be connected with the picture on the stamp. Envelopes sent to the first-day post office with money to purchase return postage will have the new stamp on them, canceled on the first day of issue.

Some collectors specialize in stamps honoring some person, group, or event in a nation's history, called *commemorative* stamps. Some collectors specialize in stamps printed directly on envelopes. They keep the entire envelope, or cut out about a two-by-four-inch rectangle bearing the stamp. Other specialists collect precanceled stamps. Before selling these stamps, the post office prints or hand-stamps as cancellations on the stamps the name of the place where they are to be used.

The History of Postage Stamps

In the 1830's Rowland Hill, an English schoolmaster, first offered the idea of postage stamps. Before his proposal, a Frenchman, de Villayer, had used wrappers in the 1650's indicating postage had been paid. But his system did not last long.

Hill saw postage stamps as one means to achieve increased use of the mails and increased revenue from them. Before his day, postal rates were determined by distance and by the number of sheets in each letter. The farther a letter went, the more it cost for each sheet. Hill proposed a standard rate based on weight, regardless of distance, throughout Great Britain. He set one penny a half-ounce as the rate which would encourage people to use the mails.

Hill also suggested stamped wrappers and stamped letter sheets known as "Mulready" envelopes after the designer, William Mulready. But postage stamps were an immediate success, while the wrappers and letter sheets gathered dust in the post office.

Great Britain began to use postage stamps in 1840 The stamps bore a picture of Queen Victoria. The Swiss cantons of Zurich and Geneva were the next to issue postage stamps. Brazil, in 1843, was the first Western Hemisphere country to issue stamps. In 1847 the United States Post Office began to issue stamps As early as 1842, however, local postmasters and some private letter-carrying services in the United States began issuing their own stamps. The stamps issued by postmasters, known as "postmasters' provisionals," are rarities prized by collectors. The private stamps are known as "carriers" and "locals."

Early stamps had no perforations. In 1847 Henry Archer submitted the plan for a perforating device to the British Post Office. British stamps were issued to the public perforated in 1854 and have been regularly issued in that manner since. United States stamps have been perforated since 1857, though imperforate stamps were regularly issued from 1902 until 1926 for the convenience of private companies which made vending and affixing machines. An early separating device was the *roulette* (French for "little wheel"). In rouletting, small wheels slit the paper instead of punching out little circles.

One of the most unusual uses of postage stamps came about in the United States during the Civil War. Metal money was hoarded and the war prevented issue of new coins. At first stamps and then small bills bearing reproductions of stamps were used as change. The bills were called postage currency.

One postal device has somewhat displaced stamps, particularly in commercial mailing. The postage meter, first introduced in New Zealand in 1902, was tried out in the United States in 1914. By 1949, postage-meter machines were preparing about 40 per cent of all United States mail. Modern postage-meter machines weigh mail and print the correct postage on the letter. For packages, the postage is printed on a strip of gummed paper.

From "Mania" to Science

Stamp collecting of a sort probably began as soon as stamps were issued. Many people saved the first stamps as curiosities. In 1841 a young lady advertised in a London newspaper for used stamps. She had

UNUSUAL VARIETIES OF STAMPS

Here are some interesting stamps that collectors eagerly seek: 1. A Hungarian issue of 1946, sold during a time of currency inflation. The overprint signifies the type of service for which it is valid. 2. A Belgian stamp, with a detachable label "Do Not Deliver on Sunday." 3. An Italian stamp with an advertisement below for stomach bitters. 4. A diamond-shaped Lithuanian stamp of 1923. 5. A triangular stamp of the Cape of Good Hope (1853).

about 16 thousand, but needed more to complete the project of papering her room with stamps.

By the early 1850's, stamp collecting was becoming well known. At first it was looked upon as a hobby for boys. By 1860 stamp collecting had attracted many adults. Noncollectors referred to it as a mania. In the 1860's the serious study of stamps began and stamp magazines and organizations were formed. By 1862 there were over 1,200 different stamps. In 1940, when postage stamps were 100 years old, more than 80,000 major varieties had been printed.

Stamp act. The French and Indian War (1754–63) doubled the debt of the British government and at the same time greatly increased British possessions in America. The British government therefore decided to station British troops in the colonies to prevent the French from recovering Canada, and also to defend the colonies against the Indians. Most Englishmen thought it only right that the colonies should help pay for the support of these troops. For a partial support of the troops the British Parliament therefore passed the Stamp Act in 1765. This provided that stamped paper (*see* illustration), purchased of the British government, should be used for all important documents, including newspapers.

The cause of the trouble.

This tax aroused great opposition among the colonists, partly because they thought they should not be taxed except by their own representatives, partly because they opposed the presence of British troops, and partly because the tax had to be paid in silver and thus would carry away so much of their money that it would seriously interfere with business. Benjamin Franklin, who was in England at the time, advised his countrymen to submit to the law until they could get it repealed. But a "Stamp Act Congress," representing nine colonies, met in New York City on Oct. 7, 1765, and declared that only the colonial assemblies should tax the colonists, and so paved the way for resistance. When the stamped papers began to arrive, mobs seized them, or forced the ships' captains to take them back to England. They also forced stamp commissioners to resign, so that even where the stamps were landed there was no one to distribute them.

Many officials and wealthy merchants were in favor of stopping all business which required the use of stamped papers. "Let the courts close," they said. "Let the ships lie in the harbor. Let the merchants stop importing any British goods. Let the printers stop printing newspapers." This, they said, would be perfectly legal, and it would so seriously interfere with the business of British merchants that Parliament would be forced to repeal the law. But the printers and lawyers, the small shopkeepers and laborers, who would be reduced to distress if business stopped, wanted to disregard the Stamp Act entirely. These called themselves "Sons of Liberty," and denounced the more conservative people.

Both methods of resisting the law were employed to some extent. The printers went on printing news-

papers. A good deal of trade was carried on without stamped clearance papers. The courts did some business without stamped papers. But the higher courts were closed much of the time; and the merchants formed an agreement not to import British goods, which was pretty well observed. In general there was a marked interference with business, and the poorer classes suffered greatly in the winter of 1766 for want of employment; with the result that rioting and disturbances were common.

This resistance helped to bring about the repeal of the law. Certain men in Great Britain, notably William Pitt, came to the assistance of the Americans. The British merchants, whose trade was seriously cut, pressed for the repeal of the act. In addition there was a change in the ministry, and the new ministers from party reasons were disposed to condemn the action of their opponents. The result of all of these influences was that the Stamp Act was repealed in March 1766. This step, however, was accompanied by a "declaratory act" setting forth Parliament's supreme power over the colonies in matters of taxation, as well as in all other matters of legislation. (*See* Revolution, American.)

STANDISH, MILES (also MYLES) (about 1584–1656). While the Pilgrims were in Leyden they were joined by Miles Standish, an English soldier who had been fighting in the Low Countries. In 1620 he and his wife Rose sailed on the *Mayflower* on its famous voyage to the New World. What led this military man to cast his lot with this little band will never be known; he was not one of their congregation, yet he was destined to be one of their leaders.

The Plymouth colonists soon saw that Standish's army life had been the best possible preparation for the military leadership of the colony and they made him their captain. Into his charge were given all matters of fortification and expeditions against the Indians. When the *Mayflower* cast anchor in Plymouth Bay, we are told, Standish and 16 men, "with every man his musket, sword, and corselet," set out to explore the country along the shore "marching in a single file." Little wonder that the half-dozen Indians who saw this armored procession advancing "ran away with might and main."

No one in the colony understood the Indians as did Standish. When Chief Corbitant kidnapped the colonists' interpreter and friend, Squanto, he promptly marched to the Indian village with a little company of men, rescued the captive, and brought him triumphantly back to the settlement. He knew that what the little body of white men lacked in strength they must supply in quickness and determination. In strange contrast to the bluff man of arms we see in these deeds is Bradford's picture of the Captain during the terrible winter of 1620–21, during which Rose Standish died. He went about from cabin to cabin doing whatever was most needed; cooking, washing clothes, or nursing the sick, with all the tenderness imaginable.

A charming tale of the wooing of Priscilla Mullins is told by Longfellow in 'The Courtship of Miles Standish' (*see* Alden, John). Whether this be true, we do know that Captain Standish later married a young woman who came over in the *Ann*. They and their children lived happily across the bay from Plymouth at Duxbury, a settlement founded by a group of colonists from Plymouth.

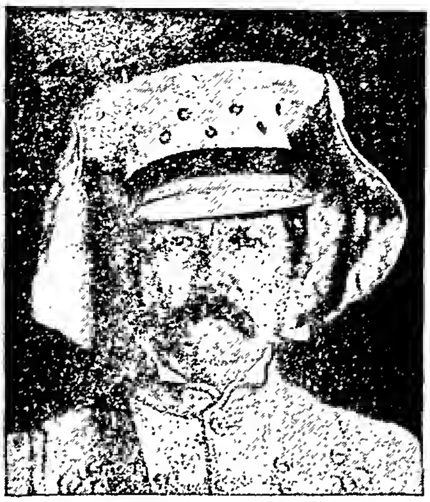
STANLEY, SIR HENRY MORTON (1841–1904). "The river was calm, and broad and brown. Armies of parrots screamed overhead as they flew across the river; legions of monkeys sported in the branchy depths; howling baboons alarmed the solitudes; crocodiles haunted the sandy points and islets; herds of hippopotami grunted thunderously at our approach; elephants bathed their sides by the margin of the river; there was unceasing vibration from millions of insects throughout the livelong day; from the shores came the unearthly cry of the relentless cannibals." So wrote the explorer Stanley, of the Congo River in Africa when, the first white man to see these scenes, he descended 2,000 miles of its great extent to its mouth. Far in the interior he had embarked on its waters, without knowing what river it was or where it would lead him. Livingstone, who had discovered the stream near its headwaters, thought it was the Nile because it flowed northward. But Stanley found that presently the river turned westward, and he began to suspect that it might be the Congo, whose mouth on the west coast was already known.

Stanley had entered Africa from the east coast, from Zanzibar, so that when he arrived at the Congo's mouth he had made the complete crossing of this equatorial belt of Africa from east to west, opening up this vast region to the world. The expedition took three years (1874–77), and cost the lives of all three of his white companions, and of many natives.

The results of this expedition were enormous, for it led directly to the formation of the Congo Free State and the exploitation of the region. Stanley himself, after England had refused to interest herself in the new territory, returned to Africa and under the patronage of King Leopold II of Belgium, head of the Congo state, took charge of opening the country to commerce, establishing trading posts and river navigation. The great abuses which sprang up later under Leopold's rule were in no way Stanley's fault, as he was throughout the friend of the natives and worked for their good.

Stanley's interest in equatorial Africa had been first aroused some years before, when as a newspaper correspondent he undertook an assignment from the New York *Herald*. "Go find Livingstone," said James Gordon Bennett, the publisher of that paper, to him in Paris. The great missionary explorer David Livingstone had at that time been lost to sight in the interior of Africa for five years. Almost everyone thought him dead. Stanley set out from Zanzibar for the interior on March 21, 1871. After conquering almost insuperable difficulties and trav-

eling for nearly eight months he came to an Arab town named Ujiji on Lake Tanganyika. He had heard rumors from the natives that a white man with a white beard was in this town, and he marched into it between hope and fear. Good fortune was with him, for he found Livingstone, old, ill, and with scanty supplies. When he actually saw before him the great man for whom he had been searching so long, all young Stanley found to say was, "Dr. Livingstone, I presume!"


HENRY M. STANLEY

Stanley stayed in Ujiji four months and became a devoted admirer of Livingstone, but was unable to persuade him to leave his work and return to civilization. After the old missionary's death Stanley determined to continue his work of exploring the interior of Central Africa. The expedition down the Congo was the result.

Stanley's life throughout was a curiously adventurous one. His name was originally John Rowlands and he was born in Wales. After a youth of extreme poverty, he ran away to sea and landed in New Orleans, where he was adopted by a merchant named Stanley, whose name he took. He fought with the Confederate army in the Civil War, was for a time in the United States navy, and later became a newspaper correspondent. In this capacity he traveled in Asia Minor, and accompanied an expedition under General Hancock against the Indians in the West, a British expedition against the emperor of Abyssinia, and still a third, also British, to Ashanti on Africa's west coast.

After Stanley had established navigation on the Congo he made still another expedition across that continent. This time he traveled from west to east, ascending the Congo and cutting across the vast tropical forest to Lake Albert. The object of this last expedition was to rescue Emin Pasha, a German agent of the Egyptian government who was cut off in equatorial Africa by a native uprising. With Emin, Stanley arrived at Zanzibar, the point of departure for his earlier expeditions, in December 1889.

This expedition ended Stanley's active career in Africa. His later years were spent in England, where he again became a British subject, was elected to Parliament, and was made a knight. No one did more to open up the interior of Africa to knowledge and civilization, and few have had a more adventurous career than this orphan boy who was honored at his death with a public funeral in Westminster Abbey.

Stanley's writings include: 'How I Found Livingstone' (1872); 'Through the Dark Continent' (1878); 'In Darkest Africa' (1890); 'My Dark Companions and Their Strange Stories' (1893); 'My Early Travels and Adventures in America and Asia' (1895); 'Through South Africa' (1898); 'Autobiography' (edited by his wife, 1909).

Stanton, Edwin McMasters (1814–1869). The task of administering the War Department of the American government through the Civil War fell to Edwin M. Stanton. To him was given the handling of thousands of men and millions of dollars at a time when the very existence of the country depended on military strength.

The man who bore this great responsibility was born in Steubenville, Ohio. He was the eldest of the four children of David and Lucy (Norman) Stanton. His father was a physician of Quaker stock. Stanton began his political life as a lawyer in Ohio and an antislavery Democrat. He had attended Kenyon College and was admitted to the bar in 1836. He practiced law in Steubenville and later in Pittsburgh, Pa. While still practicing in Ohio he met Abraham Lincoln as an associate in one of his cases and disdainfully asked, "Where did that long-armed creature come from, and what can he expect to do in this case?"

In 1856 Stanton moved to Washington, D.C., where he had a large practice before the Supreme Court. In 1860 he was appointed attorney general by President Buchanan. He was violently opposed to Lincoln in 1860 and referred to him as the "original gorilla." He retired from office at the end of Buchanan's term.

In spite of his opposition to Lincoln and to the Republican party, the president offered him the post of secretary of war in 1862 to replace the inefficient and corrupt Simon Cameron. He accepted the position, as he honestly said, "to help save the country."

Stanton was tactless and stubborn but an able administrator. Whenever necessary, Lincoln managed to "plow around him." The president recognized Stanton's ability. When pressure was exerted to remove the unpopular secretary from office, Lincoln replied, "If you will find another secretary of war like him, I will gladly appoint him." In the meantime Stanton's estimate of Lincoln had undergone a radical change. At Lincoln's death Stanton said, "There lies the most perfect ruler of men the world has ever seen." (*See also* Lincoln, Abraham.)

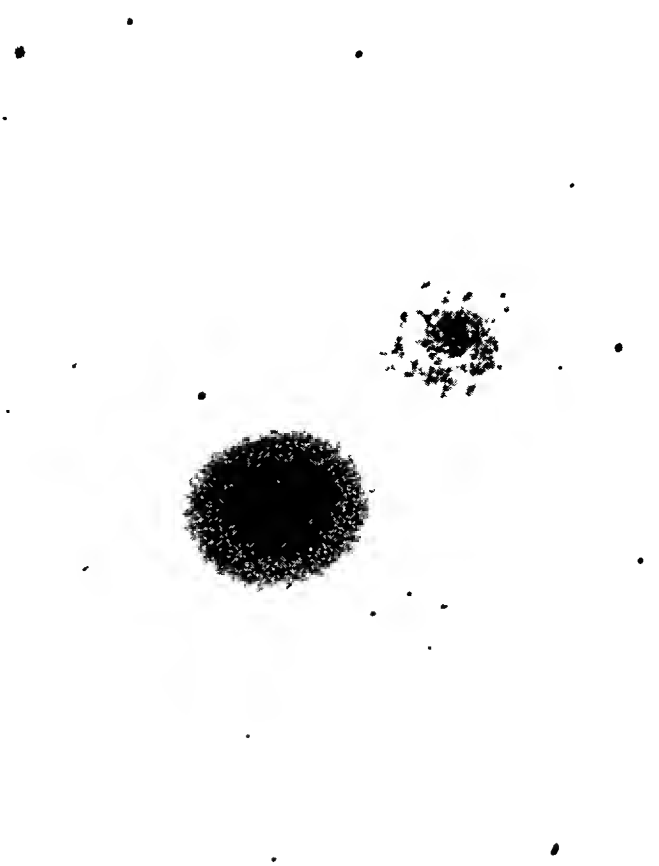
After Lincoln's assassination Stanton continued to hold his position under President Johnson, until 1868. His relations with Johnson were never pleasant, and finally the president sought to remove him from office. This attempt led to the impeachment of the president (*see* Johnson, Andrew). When the proceedings against Johnson failed, Stanton resigned and returned to the practice of law. The next year he was appointed by President Grant to the United States Supreme Court, but he died four days after the appointment was made. (*See also* Civil War, American; Reconstruction Period.)

ATOM FURNACES *in* SPACE

STAR. Men of the ancient world thought that stars were tiny lights on the inner side of a great, hollow globe. They made up stories about them and gave names to the patterns that they saw in the sky night after night and year after year (*see* Constellations; Zodiac). Only with the birth of the modern science of astronomy did men start to become aware of the true nature of the universe. (*See also* Astronomy.)

Scientists still cannot say exactly what a star is. They do, however, know many facts about these myriad companions to the sun which lights and warms the earth.

The star which we know best is our own sun. It is the center of our solar system and the earth revolves around it. The sun is only one of the billions of stars in the vast universe that surrounds us. In turn, our solar system is only a small segment of the great galaxy we call the Milky Way; and many other galaxies are visible through telescopes. (*See* Sun and Solar System; Planets; Nebulae.)



This photograph, made with Mount Wilson's 100-inch telescope, shows two principal types of galactic systems. At the left is the glowing cloud of an elliptical, or globular, galaxy. The spiral galaxy on the right is similar to our own system, which we call the Milky Way. It represents an earlier stage of galactic evolution.

Nature of the Stars

Astronomers generally agree that most stars have approximately the same diameter as our sun. Some, however, are only one tenth its size; while others may be more than 100 times as large.

Stars are actually great globes of incandescent gases—their brightness depending upon their size and temperature. These glowing spheres are enormous powerhouses of atomic energy; and it is now believed that this energy is released by a process similar to the thermonuclear reaction that takes place in an exploding hydrogen bomb (*see* Atoms, subhead "Natural Fusion in the Sun"). A star's chemical content is determined through the science called *astrophysics*. In many stars the gases may be unbelievably thin, with the particles or atoms of matter in the gas far enough apart to make it a thousand times less dense than the air we breathe. Yet, for all its thinness, matter *is* there, perhaps a million times as much as we have in the earth. Hydrogen, oxygen, and nitrogen are there, and perhaps iron, calcium, and other elements too. In cooler stars the matter may be more nearly liquid, more like the boiling iron in a blast furnace. In some old and comparatively cold stars, the matter may be packed so densely that a cubic inch of it would weigh a ton. Such stars are called *dead* or *dark*.

Astrophysicists determine these facts with spectroscopes. With these instruments they can tell from the light a star gives what kinds of matter it contains and how hot it is (*see* Spectrum and Spectroscope). How do astronomers locate dead stars that give no light? Some of them are detected because they are near bright stars, and gravitation keeps the two swinging around each other. From the motion of the bright star, the nature of the dark star can be determined. In some such double stars, or *binaries*, the dark one swings regularly in front of the bright one and cuts down the light. Such a pair is called a *variable star*, or *eclipsing binary*. Still other dark stars give off infrared radiation which can be photographed on special plates (*see* Infrared Radiation).

The Number of Stars

Astronomers can only estimate the total number of stars. One way this is done is to measure the amount of light and other effects given by a known number of stars and compare these with the effect from the entire sky. One such estimate gives a total of 30 billion. Some astronomers, however, say that the Milky Way alone has some 100 billion stars, and the Milky Way consists merely of the stars nearest us. These are gathered into a cluster called a *galaxy*. Farther out are other galaxies (sometimes called extragalactic nebulae). If the high estimate for the Milky Way

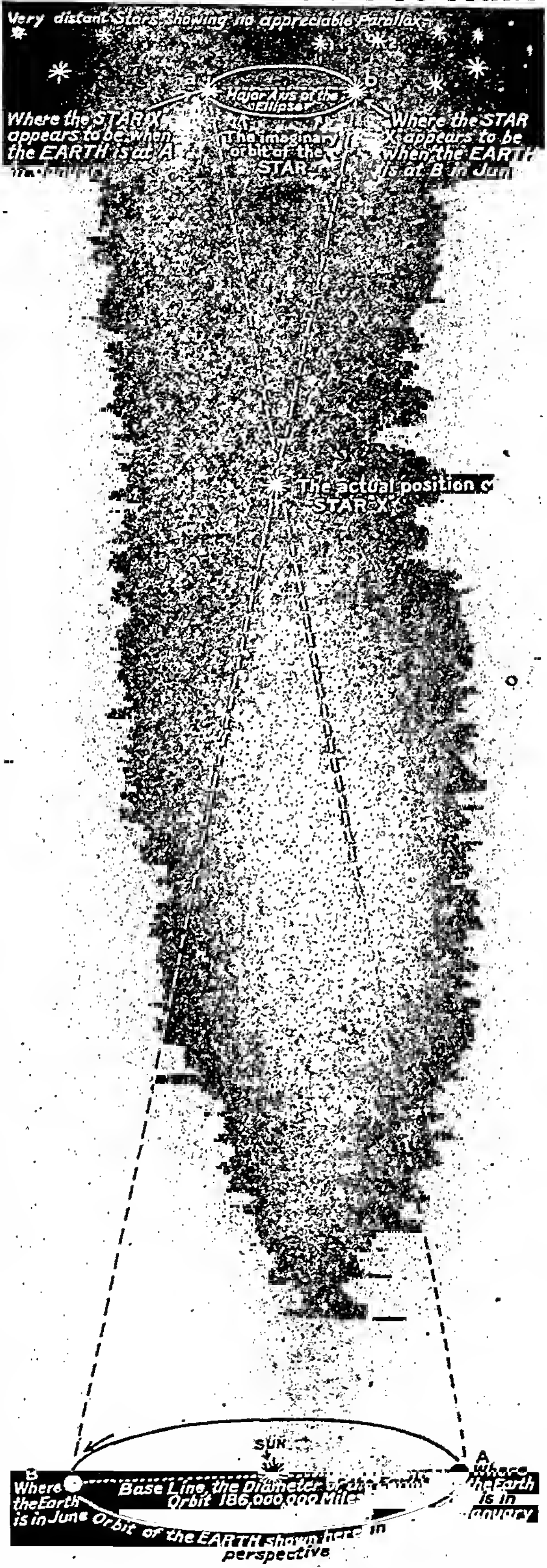
alone is near the truth, the total number of stars must be inconceivably large. The picture on the preceding page shows two types of galactic systems in unusual proximity. For a picture of the great spiral nebula in Andromeda, *see* Nebulae.

Distances to the Stars

The distances to the stars are so great that it is convenient to measure them in *light-years*, that is, the distance light travels in a year, at the rate of 186,000 miles a second. The nearest visible star to the earth is Alpha Centauri, seen in the southern hemisphere. This is 4⅓ light-years away. In the same constellation is a smaller and perhaps nearer star, Proxima Centauri, which can be seen only with the aid of a telescope. Another recently discovered rival is the dim star Wolf 424. The distance to this star is estimated to be 3.7 light-years. In contrast, some of the nebulae are thought to be more than a million light-years away.

How can such distances be measured? One way is by measuring the *annual parallax* of the star. This process consists in observing the star from one position in the earth's orbit and then six months later from another one, and computing the breadth of the resulting angle. The distances are so great that the angle is very slight, and the measurements must be so delicate that the parallax of only a comparatively few stars has been determined with approximate accuracy. The nearer the star, however, the easier it is to measure this angle, so we know that the many stars which are still unmeasured lie a greater distance than those for which the parallax has been measured. The first parallax determination was made by Bessel in 1838, and is regarded as one of the greatest achievements of science.

MEASURING DISTANCES TO STARS



Suppose that an astronomer wants to learn the distance to star "X." From position "A" of the earth he measures the angle between "X" and several exceedingly distant stars, such as "1" and "2." When the earth is at "B," he repeats the measurements. From his knowledge that the changes he detects in the angles are caused by a displacement of 186,000,000 miles in the earth's position, he computes the distance to "X."

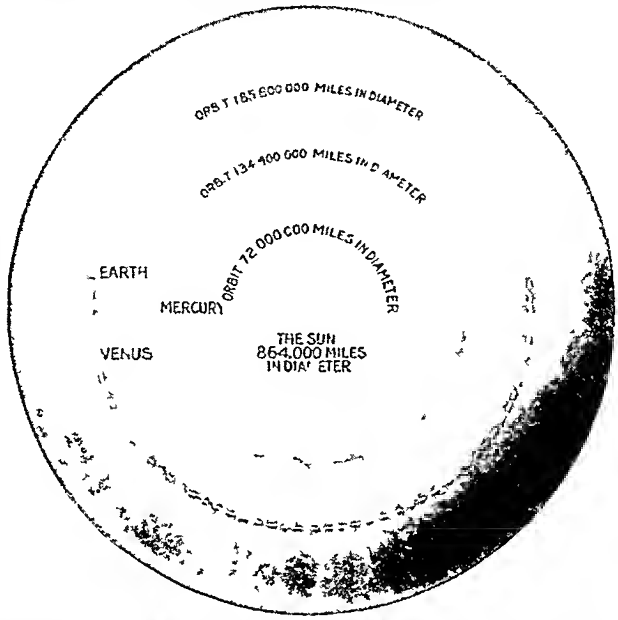
Our universe, as astronomers conceive it, is a great sphere so far across that it can only be expressed in figures that stagger the imagination, without conveying any true impression of its immensity. In the central portion of this sphere lies the Milky Way, or Galaxy, a great concourse of stars and nebulae which has been compared to a huge grindstone, with various rifts and breaks (*see* Nebulae). Most of the stars cluster in and about this huge ring or band, growing thinner toward the Poles. The Earth and solar system seem to occupy a position somewhere near the center of the grindstone, yet the movement of the stars is such that some day we may be carried to the outer edge.

If we look at the stars at a particular time at night, and then view them an hour or so later, we see that they have changed their apparent positions in the heavens—that is, with the single exception of the Pole Star. But this change is due solely to the rotation of the Earth on its axis. From a railroad train it often seems as if the telegraph poles were in motion, and the man who observes the stars gets a similar impression regarding heavenly objects. Even the ancients realized that at any particular hour on any particular night of the year—at 12 o'clock midnight on January 1, for example—the stars always present the same picture, and for that

reason they called them "fixed stars" as opposed to the planets, which they named the "wanderers."

But the stars are not really fixed, any more than the Earth and the Sun and the Moon are fixed. They are moving among themselves with enormous velocity, and so far as we now know, almost in straight lines. Our Sun, which is itself a star, is taking the solar system along in the general direction of the bright star Vega at a rate estimated as fully 700 miles a minute. At that rate, it will take our system a little over 400,000 years to arrive at the point where Vega now is, if our motion remains unchanged. Some of the other stars move so fast that it seems certain that they will some day escape from our universe altogether, going out into space or nothingness, or perhaps toward other universes of which we have not the faintest inkling or conception. These "runaway stars," as they are called, have in some cases a velocity as high as 200 miles a second, and one of these "speed demons" of the sky could go completely around the earth in a little more than two minutes.

A STAR THAT MAKES OUR SUN A PIGMY



You have been taught to wonder at the enormous size of the Sun. Now try to imagine a star so large that the Sun would be a speck at its center, while three planets—Mercury, Venus, and the Earth—could revolve around the Sun, and still be inside the body of the star! Such is the gigantic and unbelievable size of Betelgeuse, the first of the stars to be measured by the method described later in this article. The star, with its diameter of about 250,000 000 miles, is represented in this drawing by the whole shaded circle. Yet we know that there are other stars beside which Betelgeuse itself would seem small.

Stars are ordinarily classified by "magnitudes," in the order of their brightness. In the "first magnitude" are placed the 20 brightest stars—Sirius, *Canopus, *Alpha Centauri, Vega, Capella, Arcturus, Rigel, Procyon, *Achernar, *Beta Centauri, Betelgeuse, Altair, *Alpha Crucis, Aldebaran, Pollux, Spica, Antares, Fomalhaut, Deneb, and Regulus. (Those marked with an asterisk (*) cannot be seen in northern latitudes.) In the second group are 50 stars, including the Pole Star and the two Pointers. In the third group we have 160; in the fourth, 500; in the fifth, 1,500; in the sixth, 4,000; and so on until in the magnitudes between the 16th and 17th there are supposed to be more than 50,000,000 stars, none of which, of course, can be seen without the most powerful telescopes. The human eye unaided by a telescope cannot see stars of less than the sixth magnitude.

The stars seem to twinkle because of the effect of the Earth's atmosphere on the light waves.

The natural groups or constellations which the stars seem to form in the sky have been given various fanciful or legendary names—for example: Ursa Major (the Great Bear), Lyra (the Harp), Taurus (the Bull), and Orion (the Warrior) (*see* Constellations). In our system of cataloging it is usual to designate the stars in each constellation by Greek letters in the order of their brilliance. Thus the pointer star nearest Polaris is named, according to this system, Alpha Ursae Majoris (brightest star of the Great Bear).

Let us consider for a moment some of the brightest stars. Most important to navigators and explorers is Polaris (the Pole Star), which, though it appears to us as a somewhat dim star of the second magnitude, is disclosed through great telescopes as a triple sun—really three stars instead of one, but so far away that they cannot be distinguished by the naked eye.

The most brilliant of all the stars is Sirius, the "Dog Star," best observed about the first of March. This great sun, which is more than three times as large as our own, has had an interesting career in the annals of astronomy. The discoverer of Halley's comet was the first to suspect that Sirius was not behaving exactly as he should, but it remained for F. W. Bessel in 1844 to work out the facts, though they could not then be demonstrated for lack of powerful enough instruments. He declared that Sirius had an unseen companion star, about half as large; that the two revolved about the same center of gravity; and that they were approaching the solar system at the rate of about 360 miles a minute. An American, Alvan G. Clark, found this companion star with a new telescope he had constructed, and thus Bessel's computations were verified beyond the shadow of a doubt.

Sirius is comparatively near to us, being the third in distance from the sun. But just to give some idea what "near" in this connection means, let us set down the figures. Sirius is 51,000,000,000,000—51 trillion—miles from our Earth!

It happens that the companion of Sirius does not interfere with the light it sends to the Earth; but in the case of Algol, which also has a companion star, a regular eclipse occurs. Algol means "Demon," and it was so called by the Arabs because it shines with

the brightness of the Pole Star for about two and a half days, when suddenly its light is reduced by two-thirds; then in a few hours it regains its former intensity. This peculiar behavior, it has been discovered, is due to Algol's dark companion which, in circling about, gets between the star and the Earth and shuts off part of the light which we receive from it.

Over 50 eclipsing "variables" of the Algol type are known and it is estimated that one star in every four has a partner or companion star. More than 13,000 such stars have been observed and counted.

Vega is not only interesting because the solar system is traveling towards it, but because in about 12,000 years it will become the north star instead of Polaris. This is due to what is called the "precession of the equinoxes," which causes the true north-and-south axis of the Earth to move about in a circle with respect to the stars, like the upper part of a spinning top.

When Stars Explode

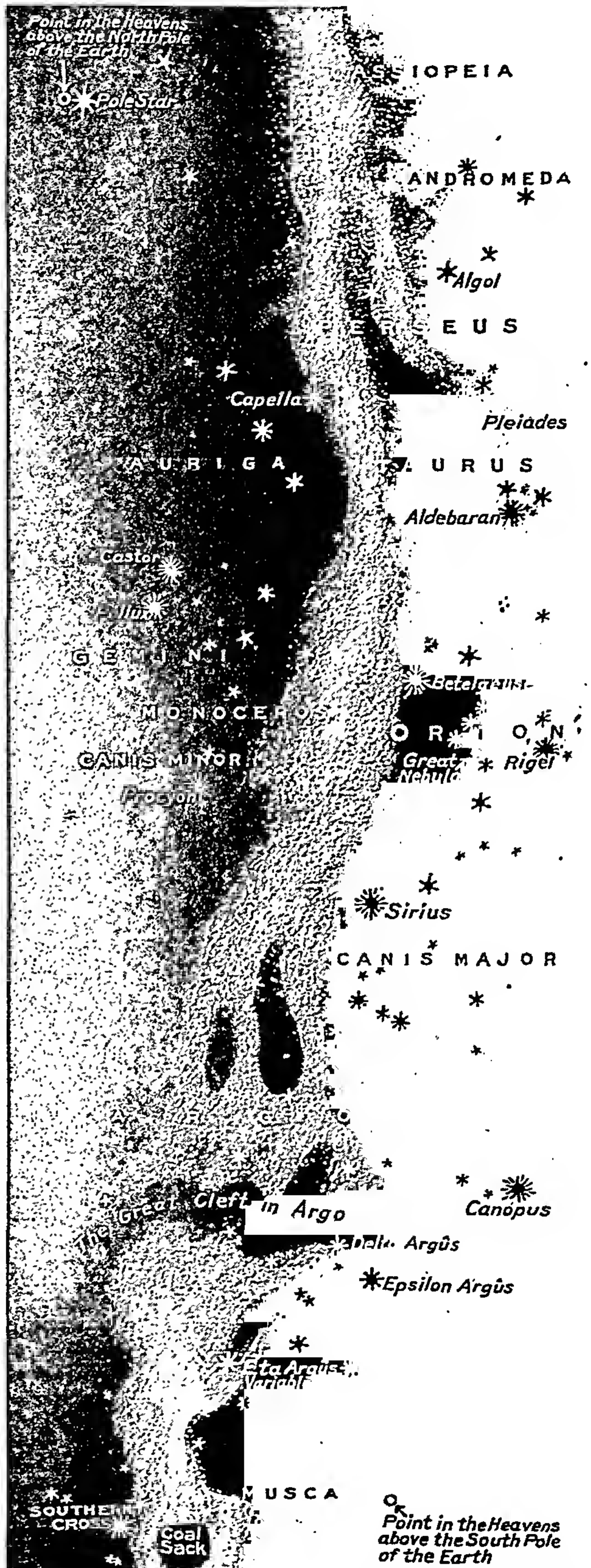
Sometimes stars explode. A star which is ordinarily so dim that it can be seen only with a powerful telescope, if at all, may suddenly flare up and become so bright that it is visible to the naked eye. Some of these *novae* (new stars) flare more than once, but they all eventually decline to their former magnitudes. One of the brightest novae appeared in the summer of 1918 in the constellation Aquila, blazing out as brightly as Sirius, then becoming invisible to the naked eye. Nova Herculis flared up twice between December 1934 and June 1935. The cause of these explosions is not certainly known. Novae are not the same as "shooting stars" (*see* Meteors and Meteorites).

The different colors of the stars—white, blue, yellow, or red—can tell us what chemical elements are present in the stars through use of the spectroscope (*see* Spectrum and Spectroscope). The spectrums obtained in this way also vary with the temperature of the source. Hence the spectroscope can be made to tell us how hot a star is. We can use this knowledge in turn to compute how much the material in any star has expanded in response to heat; then, by comparison with the temperature and bulk of our Sun, we can get a fair idea of the size of the star.

The diameter of a star can also be measured directly, if its distance is known, by a method which was devised by A. A. Michelson of the University of Chicago. All stars, large or small, are so far away that they appear as points in the telescope and so could not be measured by any previously known method. Michelson found that if a plate containing two parallel slits is placed over the objective of the telescope, the image of a star viewed through the slits will be crossed by bars of light and darkness, because of "interference" (*see* Light). If the slits are moved apart, the bars disappear. The amount of separation required to cause this disappearance depends upon the distance and diameter of the star. Using this method, members of the Mount Wilson Observatory staff found the diameter of Betelgeuse, the brightest star in the constellation Orion, to be about

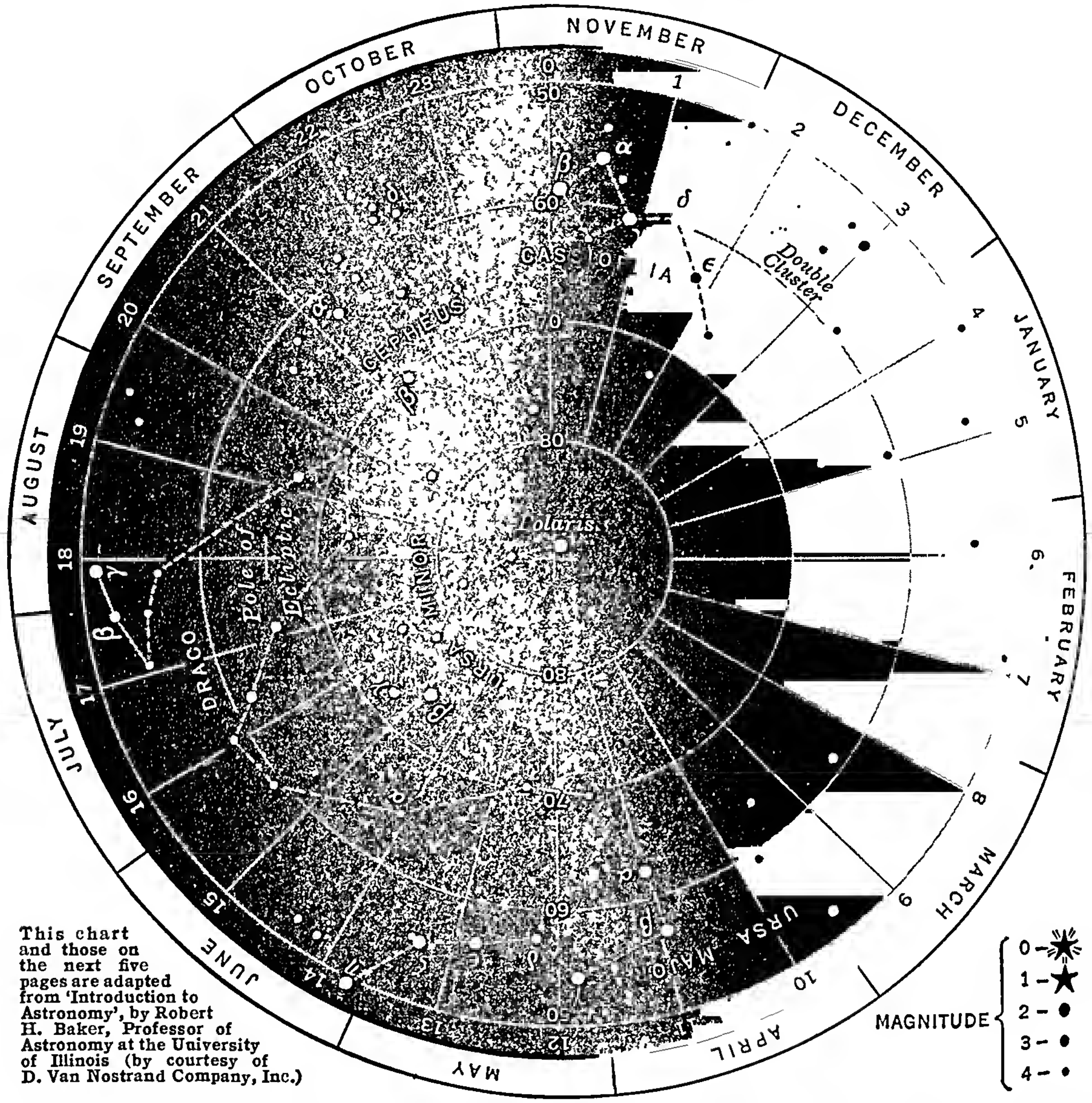
Continued on page 382

THE MILKY WAY, A "CLOUD" OF STARS



The long irregular belt of white called the Milky Way, or Galaxy, can be seen on any clear night. It is made up of a cluster of separate stars so numerous and so far away that together they look like a veil of clouds. This drawing shows the span of the Milky Way from the north to the south celestial poles—more than we can ever see at any one time.

CHART 1. THE NORTH POLAR CONSTELLATIONS



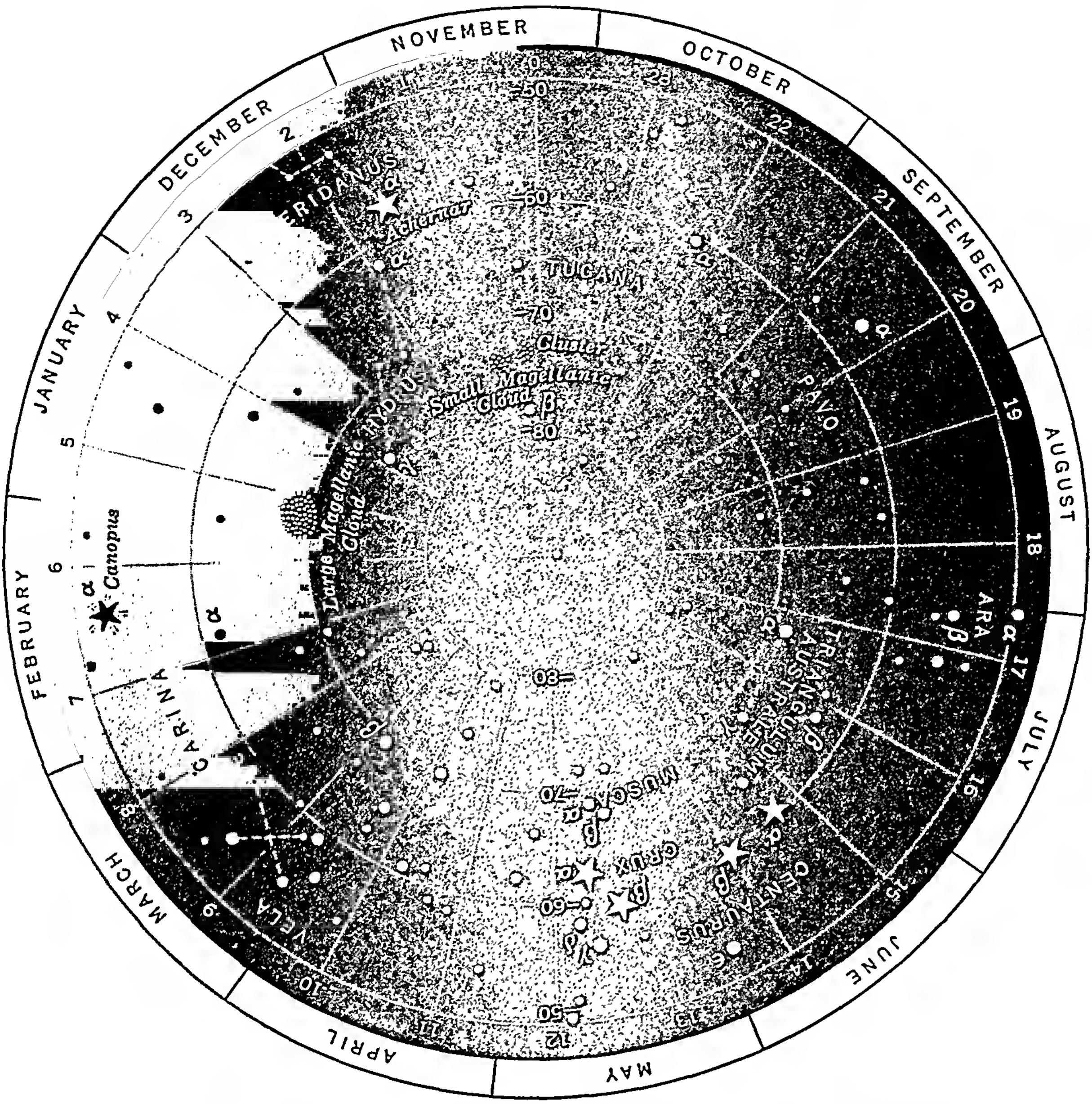
This chart and those on the next five pages are adapted from 'Introduction to Astronomy', by Robert H. Baker, Professor of Astronomy at the University of Illinois (by courtesy of D. Van Nostrand Company, Inc.)

Chart 1 shows the constellations that circle daily in the northern sky without setting, for observers in middle northern latitudes. The north celestial pole is at the center, near Polaris, the Pole Star or North Star, at the end of the handle of the Little Dipper (in Ursa Minor). The numbers around the edge are hours of right ascension and those on the vertical line are degrees of declination. The names of the months around the outside assist in making the constellations on the chart agree in position with those in the sky. Hold the chart toward the north and turn it until the date is at the top. The chart now shows the constellations as they appear at 9:00 P.M. standard time on that date. For example, at 9:00 P.M. on August 15 the Big Dipper (in Ursa Major) is bowl-down in the northwest, while Cassiopeia's Chair is tilted forward in the northeast. For a later time on that date turn the chart counterclockwise through the number of hours that have elapsed since 9:00 P.M. Thus at 3:00 A.M. on about that date the Big Dipper is right side up under the pole.

Chart 2 shows the constellations that go around the south celestial pole down below the south horizon in middle northern latitudes and never rise into view. These include the celebrated Southern Cross (Crux). When we travel south, the North Pole drops and the South Pole rises toward the horizon. The areas in which stars never set and never rise grow smaller, until at the Equator all stars rise and set. If we continue on to a place somewhat south of Buenos Aires, we shall then use Chart 2 to recognize the constellations that never set and shall find that those of Chart 1 never rise.

Charts 3, 4, 5, and 6 represent the constellations that appear mostly in the southern sky in the early evening at each of the four seasons in middle northern latitudes. The numbers at the bottom are hours of right ascension and those along the vertical line are degrees of declination. With reference to these numbered lines the right ascension and declination of any star can be read from the chart just as the longitude and latitude of a city can be read from a map of the earth. As an example, the right ascension of Regulus in the constellation Leo (Chart 3) is about $10^h\ 5^m$ and its declination is about 12° north. The sun, moon, and planets are not

CHART 2. THE SOUTH POLAR CONSTELLATIONS



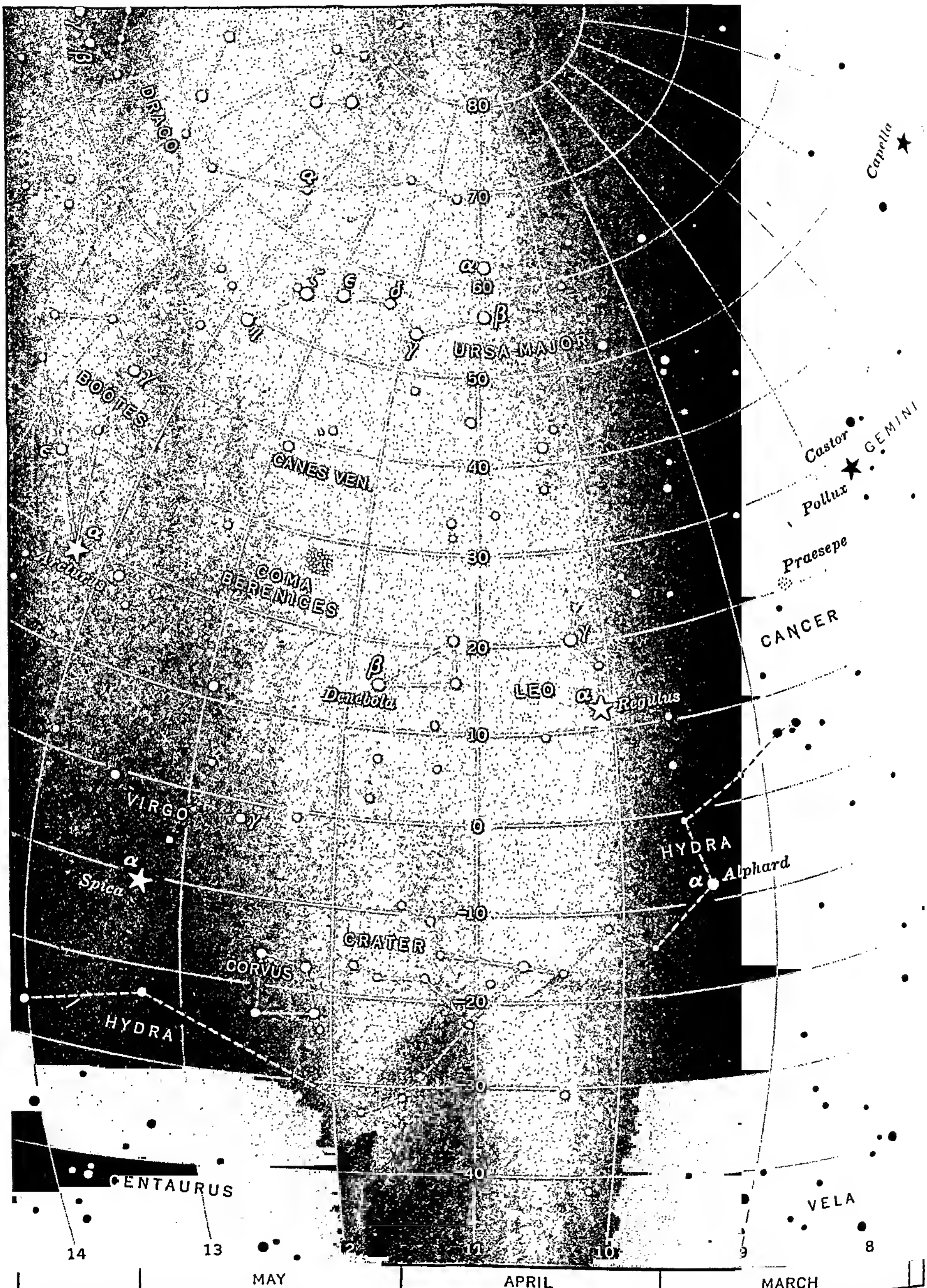
shown on the charts, of course, because these bodies move about among the constellations. Their positions (right ascension and declination) may be found for any date in the American Nautical Almanac.

The four seasonal charts are to be held toward the south. The bottom of each chart represents the south horizon. The declination circle marked 0 is part of the celestial equator. Declination circle 40 passes nearly overhead in about the latitudes of New York and Chicago. The constellations near the tops of the charts are therefore in the northern sky; these are more conveniently arranged in Chart 1. The reason for extending the seasonal charts to the north celestial pole is to show the relations between the southern constellations and the familiar ones in the north. Notice, for example, in Chart 3 that the bright star Arcturus is readily found by following the curve of the Big Dipper's handle.

Broken lines emphasize the prominent geometrical figures formed by the stars, figures such as dippers, squares, and crosses which are familiar to anyone who "knows the constellations." The names associated with these figures, particularly the figures recognized by ancient peoples, are mostly the Latin names of animals and heroes. Ursa Major, the Larger Bear, and Hercules are examples. Some of the 88 constellations that are recognized today contain neither characteristic star figures nor bright stars; these are omitted here in the interest of simplicity. For the same reason the boundary lines between the constellations are not shown on the charts. A constellation is technically an area of the heavens, and a star belongs to a particular constellation if it is within its boundary.

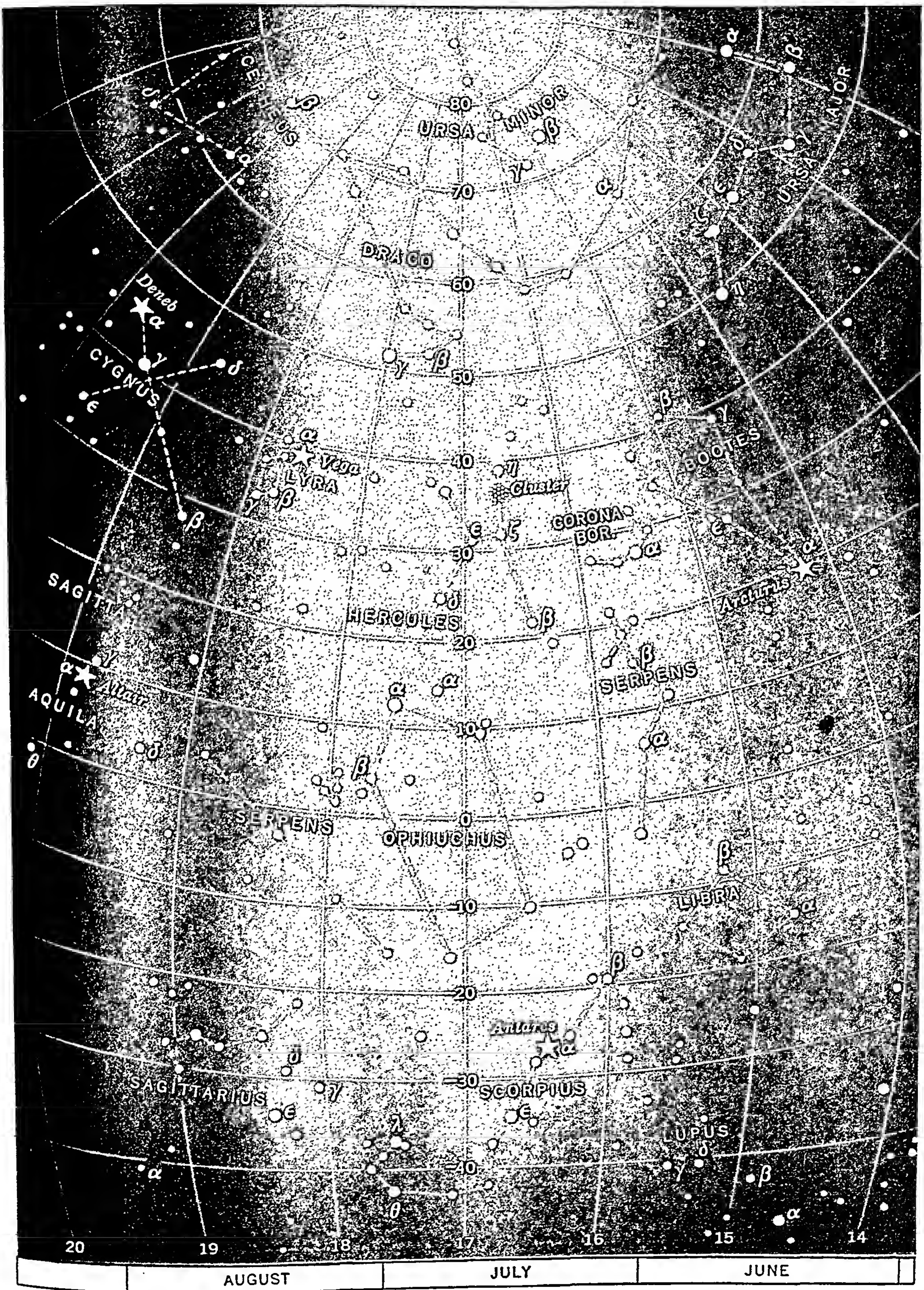
The brighter stars are designated either by special names, such as Arcturus and Regulus, or in another way which is much used in astronomy. The stars in a constellation are known by small letters of the Greek alphabet followed by the possessive of the Latin name of the constellation, and the lettering is roughly in order of brightness in the constellation. Thus the brightest star of Taurus (Aldebaran) is α Tauri and the second brightest star in Ursa Minor is β Ursae Minoris. This is why the Greek letters appear on the charts.

CHART 3. STARS OF THE SPRING



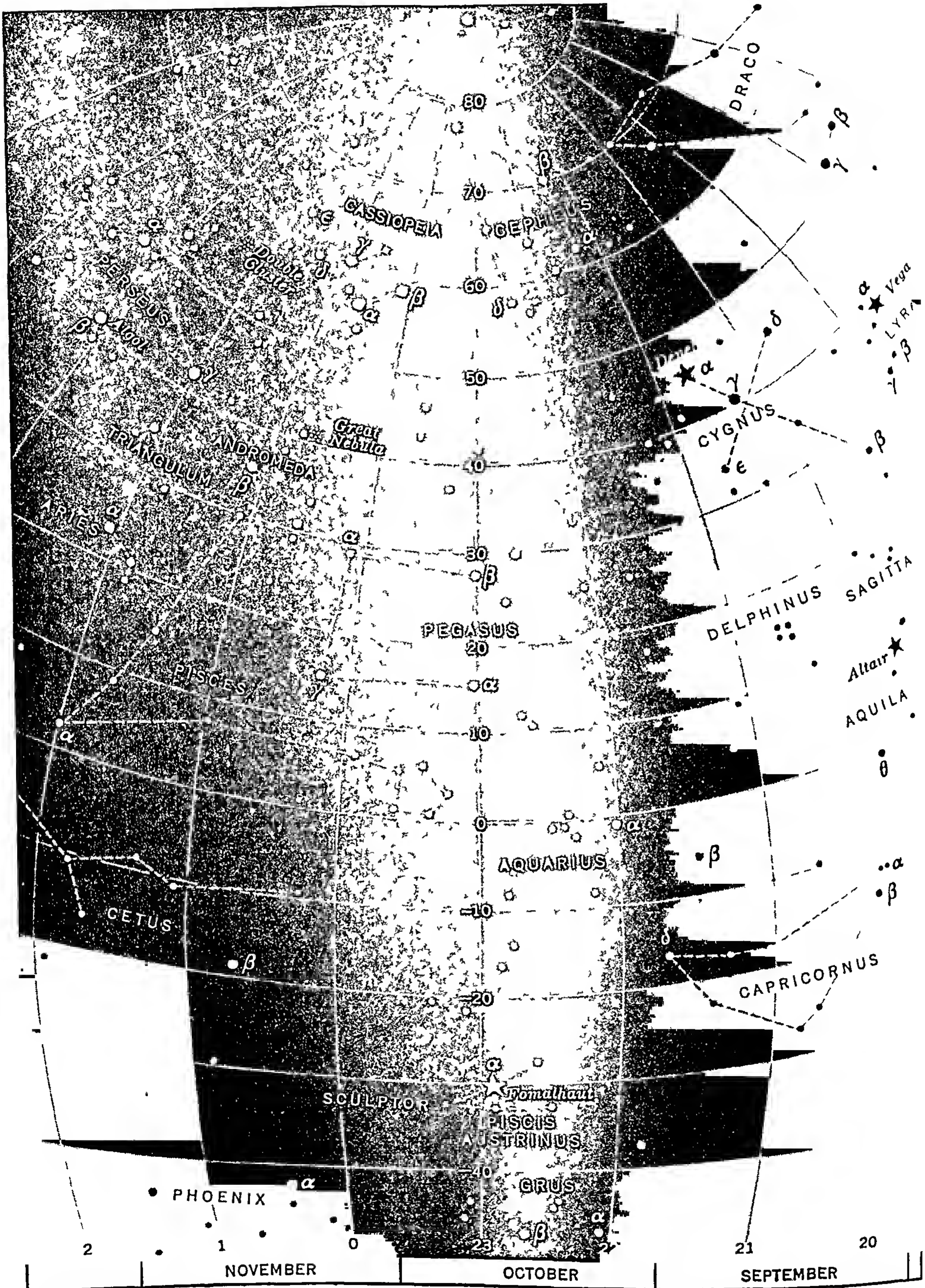
Leo, the Lion, with its Sickle figure is the dominant constellation in the southern skies of spring. Below it sprawls Hydra, the Sea Serpent. Two star clusters, Praesepe and Coma Berenices, invite the stargazer to bring out his binoculars.

CHART 4. STARS OF THE SUMMER



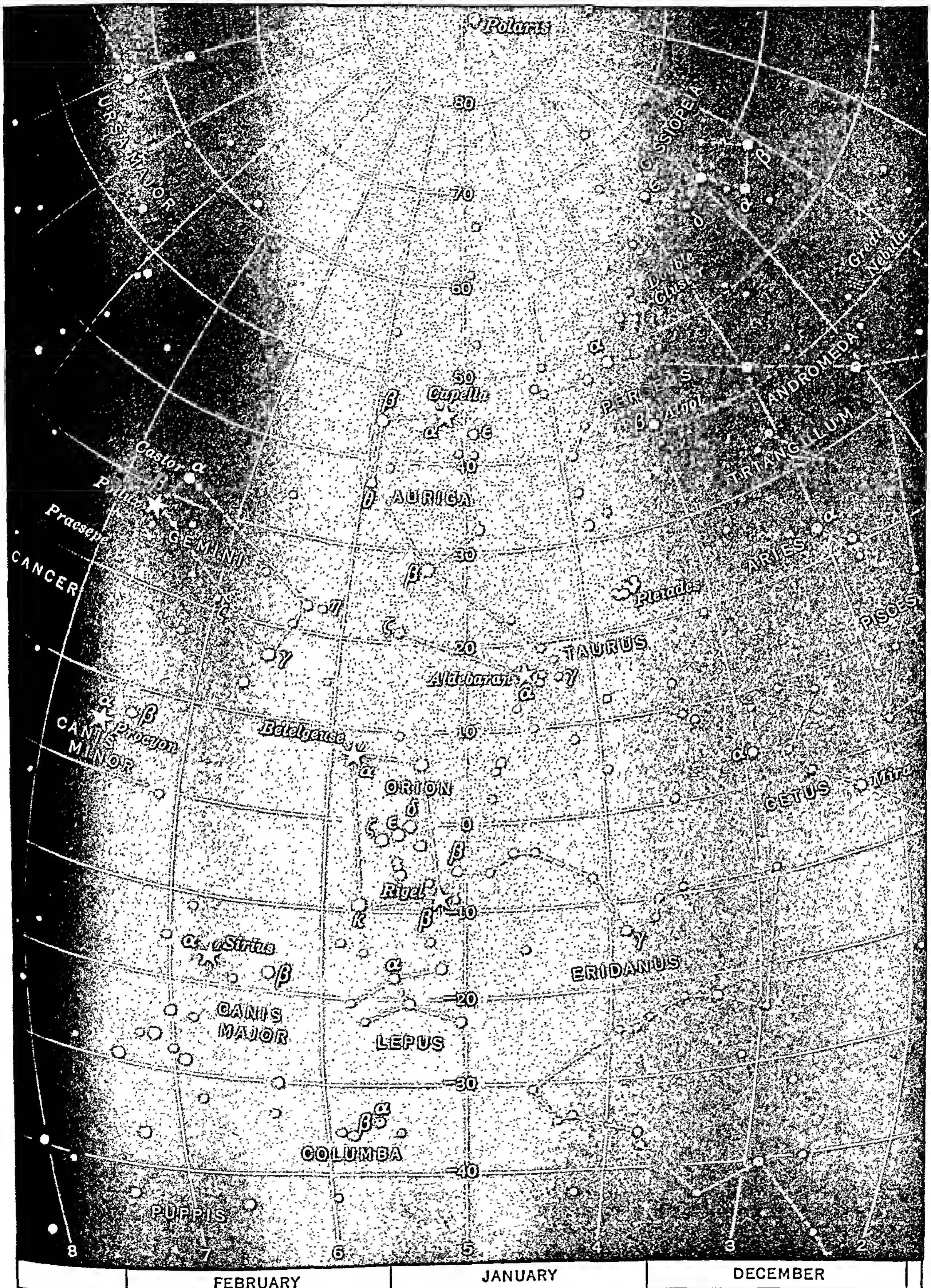
When you gaze at the fine array of constellations in the summer skies notice the contrast between blue Vega and red Antares. Cygnus, the Swan, is better known as the Northern Cross. The brightest part of the Milky Way extends southward from here to Scorpius.

CHART 5. STARS OF THE AUTUMN



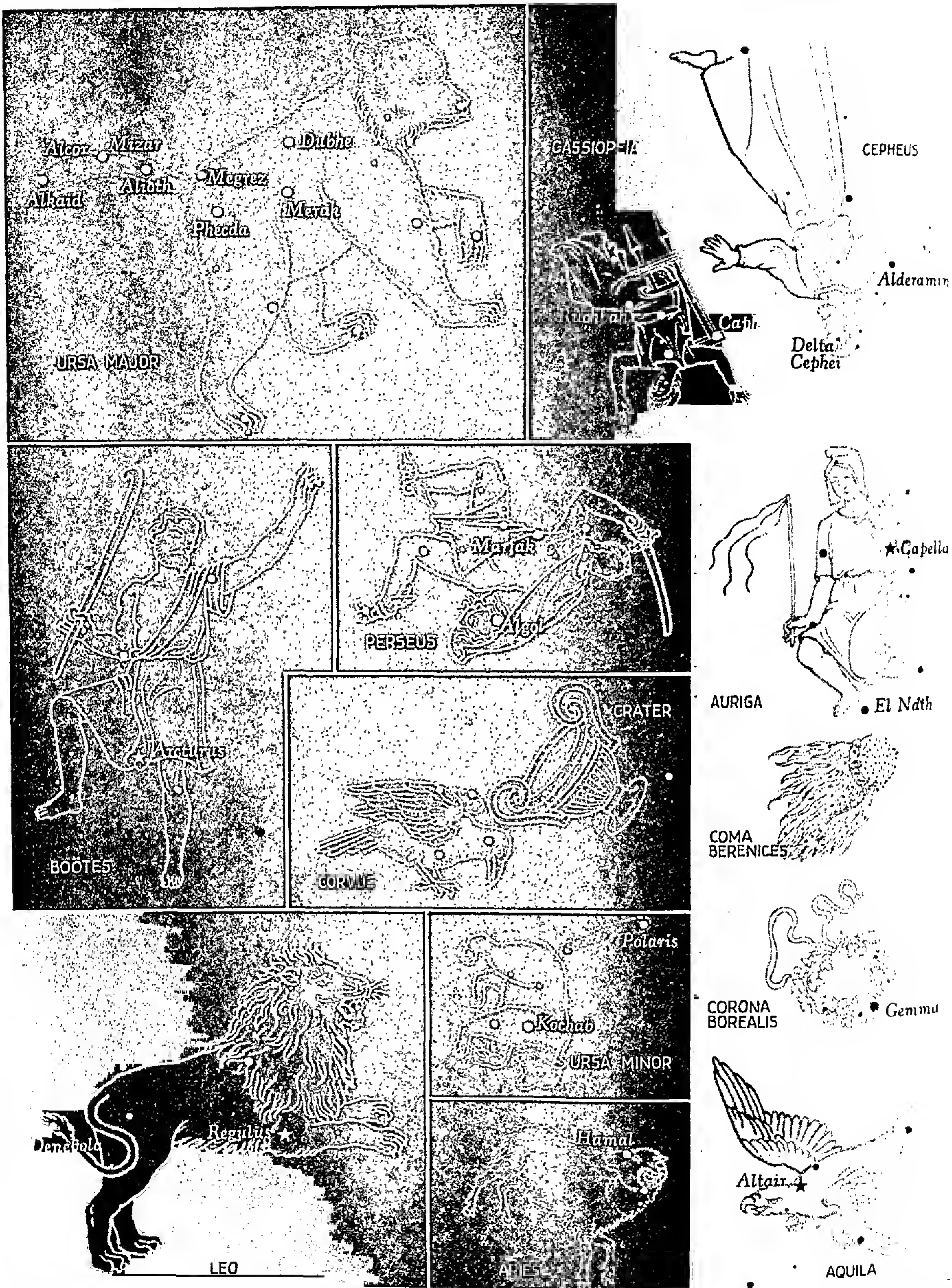
The great square of Pegasus appears in the southern skies of autumn. Imagine that this is the bowl of a dipper and look to the northeast for the handle. The handle is formed by bright stars of Andromeda and Perseus. Most of the other figures are dim.

CHART 6. STARS OF THE WINTER



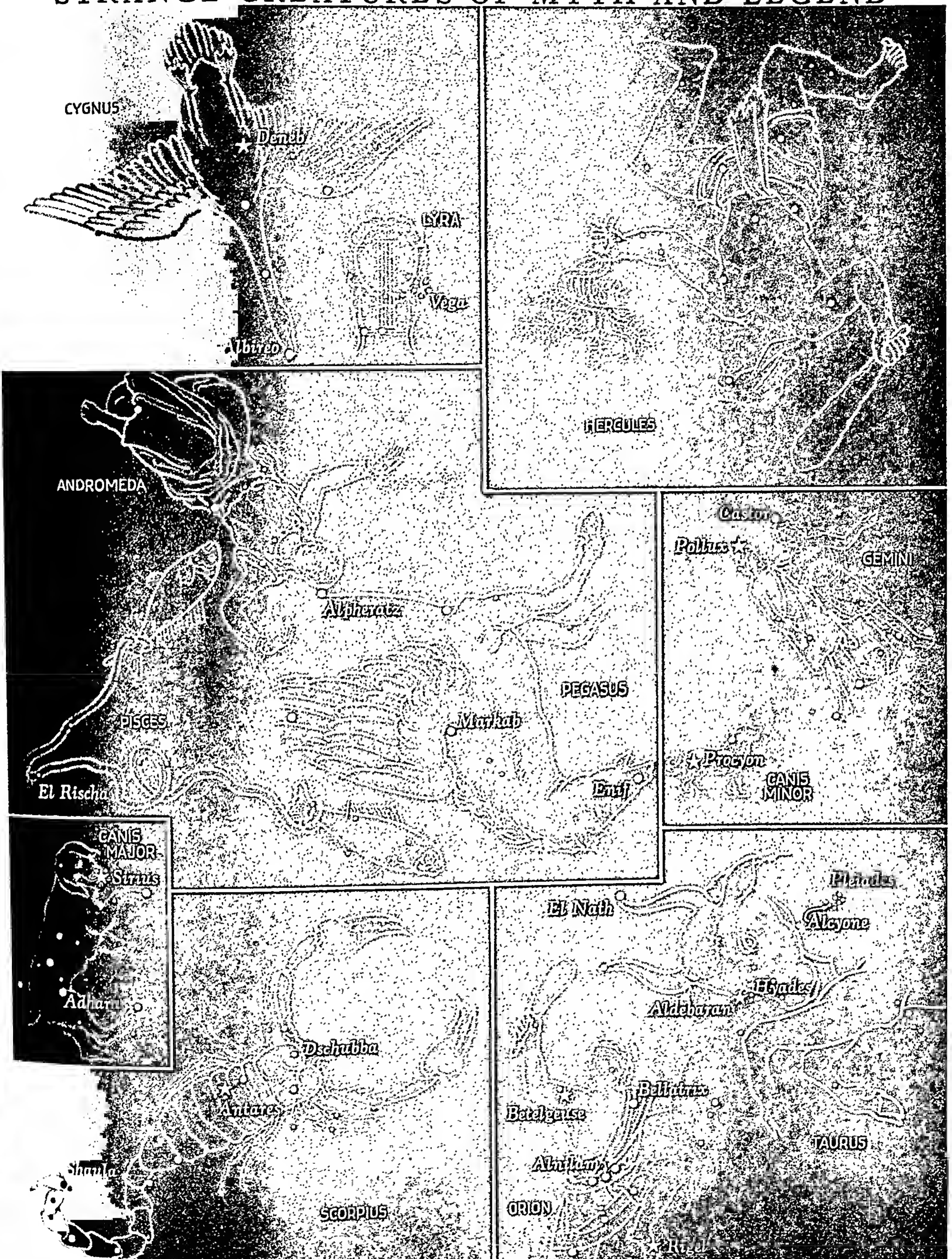
Winter brings the brightest constellations into the evening sky. Orion, with its brilliant Betelgeuse and Rigel, is the brightest of all. The line of the three stars of Orion's belt directs the eye to Sirius, the Dog Star, and to the Pleiades.

WHAT MEN OF OLD SAW IN THE SKIES



On this page and the next are shown the principal mythological figures which the ancients associated with various constellations. The orientation of each constellation is the same as in the star charts on the preceding pages, and its position in the heavens can be easily determined with the aid of those charts. For example, Leo is shown here in the same position it occupies on page S-376. The star names have come down to us from ancient times. From the maze of stars that dot the night sky, the shepherds, sailors, and desert nomads of old picked out the brightest groups, the constellations, and wove stories about them.

STRANGE CREATURES OF MYTH AND LEGEND



In the eyes of the ancients these star groups took on the shapes of gods and goddesses, of heroes and heroines, of beasts and birds. It requires a lively imagination to read this picture book of the sky as the ancients conceived it, but literature is rich in the legends of the celestial menagerie. There is the story, for instance, of Orion the mighty hunter who was stung to death by Scorpius for his boast that no animal on earth could conquer him; also the story of Berenice, the beautiful Egyptian queen whose shorn tresses were placed by Jupiter in the sky for safekeeping.

250,000,000 miles—great enough so that if its center were placed at the center of the Sun, it would extend almost to the orbit of Mars, engulfing not only the Sun, but also Mercury, Venus, and the Earth.

Young Stars, Old Stars, and Cepheids

Thanks to this knowledge of size and temperature, scientists now believe that stars are either "giants" or "dwarfs." A giant is a young star, just a mass of glowing gas, which is contracting and getting hotter because of the contraction. Sirius and most bright stars are in this class. At a certain point the heat checks further contraction. Then for a time the star remains stable with a density like water, radiating heat into space as does our Sun. Finally it cools, giving a reddish light, and dies. The Sirius companion is in this phase, and has contracted to so dense a mass that one cubic inch of it would weigh a ton.

A peculiar class of stars, recently discovered, consists of the *Cepheids*—variable stars, formerly supposed to have companions. But the spectroscope indicates that they expand and contract. Imagine a toy balloon expanding several million miles every few weeks, then contracting, and you will see what peculiar stars these must be.

VARIOUS FORMS OF STARCH GRANULES

All green plants manufacture starch, but each plant differs in its ideas of what its granules should look like and what size they should be. Under the microscope they are seen to consist of a nucleus surrounded by layers. In several of the granules in this group the layers may be plainly seen.

STARCH. Stored up in most plants, especially in the seeds, bulbs, and tubers, is a substance called starch, which is one of the most important ingredients of plant life. It has the same elements as sugar—carbon, hydrogen, and oxygen—but in different proportions ($C_6H_{10}O_5$). It occurs as small grains or granules, which differ in shape in each species of plant. Starch is found especially in cereals, potatoes, carrots, parsnips, sago, tapioca, and rice. Potatoes are about one-fifth starch; rye, wheat, and corn, almost three-fourths; oats, about two-thirds; rice, about four-fifths. Some 80 per cent of the starch of commerce comes from corn; cassava (tapioca) is next in importance. The corn is soaked in water for 48 hours, then ground and strained through sieves. After this the starch is allowed to settle in vats; then it is washed, bleached, and dried. Potato starch is made by grating potatoes, adding water, and straining, settling, washing, and drying. Wheat starch and rice starch are made by slightly different processes, to remove the gluten they contain.

As usually prepared, starch is either a white powder or irregular white lumps, which come from the breaking up of a dried cake of the material. It does not dissolve, but is merely suspended in cold water; in hot water the granules burst, forming a clear paste. This is the starch used in the laundry. When heated to about 360° F., starch is changed into the gum called dextrin, used on postage stamps. Starch and dextrin are used in industry for sizing cotton textiles, paper, and cardboard, and in making foundry cores (*see* Dextrin). Food industries use starch as a source of syrup and simple sugar (glucose or dextrose). They also prepare cornstarch and tapioca for direct consumption. These are commonly boiled and eaten as puddings of various sorts. Cornstarch is also used as a thickening material in various dishes.

Starch has high food value because digestive enzymes break it down into various sugars, which supply energy (*see* Digestion). In 1940 the first synthesis of starch was accomplished by a reverse of the digestive process. Enzymes were used to make the synthetic starch from glucose phosphate. While this was far from being a complete synthesis, it helped greatly toward revealing the chemical nature of starch. (*See also* Biochemistry.)

STAR CHAMBER. The term "star chamber" is today applied to any secret or arbitrary tribunal. The name comes from an English court that met in a room with gilt stars on the ceiling in the palace at Westminster. The king's royal council met here at least as far back as the reign of Edward III. Henry VII (1485–1509) gave the Court of Star Chamber, as it came to be called, new powers to help bring to justice great landowners and noblemen who had long been out of control. During his reign the court acted mainly in the cause of justice. Later it abused its powers. It could act on mere rumor, apply torture to exact confessions, and inflict any punishment but death. It did not make use of a jury. An outcry was raised against it during the reign of Charles I and it was abolished in 1641.

STARFISH AND SEA URCHINS. The "sea star" that one finds washed up on an ocean shore or sees clinging to some barnacle-dotted rock is a strange creature. It can be found in all parts of the world except the polar regions. The common starfish of the North Atlantic is altogether too numerous on the oyster beds, for it crawls there in thousands and destroys perhaps 100,000 dollars' worth of oysters every year in Long Island Sound alone.

A well grown starfish has the shape of a regular five-pointed star, about six inches across and an inch thick in the center. It is brown in color and covered with a mosaic of limy plates and rows of points, and near the center is a small sievelike opening. This is its dorsal (back) surface. Turn it over. The lower or ventral side shows a "furrow," broadening from

the tip of each of the five "arms" toward the center, where a circular opening (the mouth) is closed at the moment by five pointed teeth meeting at the center. That mouth opens into a loose bag of a stomach, whose folds extend out into the arms; and around it is a circular system of water-tubes, blood-vessels, egg-producing organs, and so forth.

Now put your starfish (which is not a fish at all) into an aquarium. When he crawls up its glass wall, showing his under side, you see, pushed out from rows of tiny holes in the furrow, slender glassy tubes ending in a sucker by which the animal clings to the glass. They are swollen with water sucked in through the sieve in his back, and it is by these clinging "feet" that the starfish pulls himself slowly over the sea-floor.

THE OYSTER'S WORST ENEMY

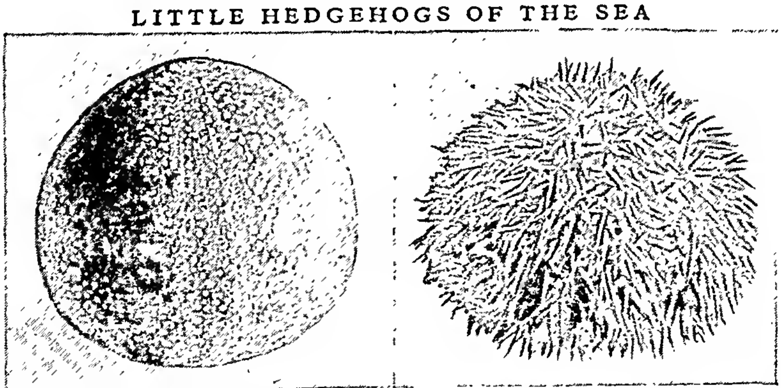
The starfish attaches itself to the shell and pulls. The oyster resists until worn out, then yields and is eaten.

Starfish are of many kinds and varied shapes. Some are very thick, with short fat arms; others are small and flat, with snaky arms (brittle stars); others have the arms many-branched (basket-fish), and so on. If a starfish loses an "arm" it promptly grows another; and if it is cut into halves, each piece grows into a new individual.

Starfish are one of the three divisions of a class of marine animals called *Echinoderms*, that is, "spiny-skinned" animals. All have their internal organs—and to some extent their outer form—arranged in five parts around a central stomach. The other two divisions are the sea urchins and the sea cucumbers.

The latter are highly prized as food in the Orient, being known as "trepang" (*see* Sea Cucumber).

LITTLE HEDGEHOGS OF THE SEA



Why a creature that looks like this should be called an "urchin" seems odd until we know that "urchin" in this connection is a contraction from "hérisson," a French word meaning "hedgehog." That is plain enough, isn't it? On the left you see the Sea-urchin with his prickly overcoat removed.

The sea urchins are as various in shape as the starfish. Some, like the sand dollars, are as flat as a thin cookie, and when you rub off the velvet-like skin you find on the lower side a five-pointed pattern of holes for tube-feet, precisely as in a starfish. Another kind has the shape and bigness of a bun; and here, again, under the spiny coat of its flat lower side, you can see the five furrows. In the spherical or egg-shaped sea urchins, these furrows extend up the sides, and the tube-feet are longer than in starfishes. By means of these and its spines, the animal can move along at about as slow a rate of travel as one can imagine. But these are not restless folk, and most of them sit calmly where they find themselves, hoping to be overlooked in their dull green or purplish coat by the big fishes, turtles, and other enemies who consider their soft insides good eating. Their bristling spines which protect them against small fishes, crabs, worms, etc., make small sea urchins resemble a chestnut-bur; while the large ones are really formidable to anything less than a ground-shark. In among the spines, which are mounted on a sort of hinge and may be waved about, are scattered many queer flexible appendages ending in a sort of finger and thumb. With these the urchin (which is derived from the French word for "hedgehog") picks off and throws away particles of drift and dirt that get entangled in his rough overcoat. All sit or move about face down and get their living by scooping up mud, out of which the stomach extracts nourishment from the minute life it contains, or by nibbling edible things which adhere to rocks and weeds.

Every summer starfishes and sea urchins lay great numbers of minute eggs in the water. Most of these are swallowed by sea anemones and other creatures. From a few are hatched strange young (*larvae*) that drift until (in most cases) they are eaten by some creature. Occasionally one settles safely on the bottom, where it grows into an adult.

Starling. The starling is a bird foreigner whose value as an American citizen bird lovers question. In 1890, 60 specimens were freed in Central Park, New York City. They have spread to the Great Plains and south to Florida and Texas. Noisy and quarrelsome, they drive away more attractive songbirds; and huge flocks roosting on public buildings create a serious problem in cleanliness. The starling resembles a blackbird, but it belongs to a different family (*Stur-*

nidae). It may be distinguished from the blackbirds, which have long, rounded tails, by its short, square tail and by its longer, heavier yellow bill. The bird is about 8½ inches long. The plumage is dark metallic green and purple, tipped with buff.

Starlings nest in tree holes and around buildings. There are four to seven greenish-blue eggs, and two broods are raised each year. The birds feed on insects and on fruit. (For pictures in color, *see* Birds; Egg.)

In Europe, where the birds are less numerous, they are great favorites. A close relative of the starling is the myna. The crested myna of South China has been introduced and naturalized in British Columbia. Mynas can be taught to talk.

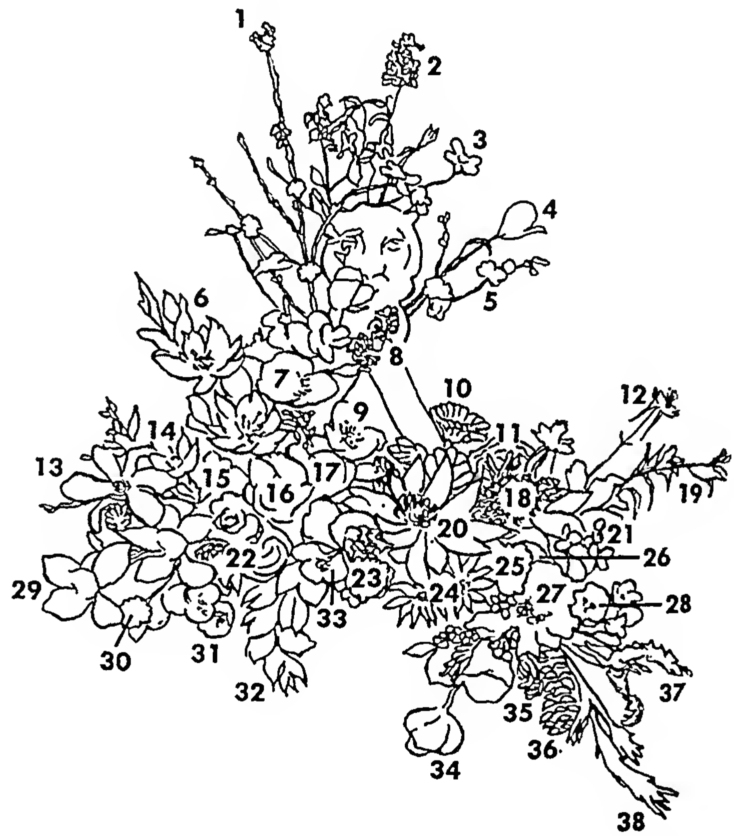
About 70 species of the starling family are distributed throughout Europe, Asia, and Africa. The scientific name of the bird in the United States is *Sturnus vulgaris;* of the crested myna, *Aethiopsar cristatellus.*

STATE FLOWERS. Through the ages flowers have served as symbols and emblems. The lily symbolizes purity; the violet, modesty; and the orange blossom, marriage. Many nations have flower emblems, such as the shamrock of Ireland and the fleur-de-lis of France. These are often associated with history, tradition, or legend. The United States has no national flower, but each state and the District of Columbia has chosen a flower as its own.

Choices were made by school children, women's clubs, or other groups. In most states, the state legislature officially adopted the flower by a resolution or other action. Many of the states have also passed laws protecting their state flowers from being picked or destroyed on public lands.

The color picture on the opposite page shows a bouquet of all the state flowers; the key picture and the table below identify the flowers by states. Many of the state flowers are wild flowers that grow abundantly throughout the state. Some are tree blossoms; and one, Maine's, is a pine cone and tassel. A few are garden flowers. One of these, Ohio's scarlet carnation, was chosen because it was the favorite flower of President William McKinley, a "native son." With the District of Columbia's American beauty rose, there are 38 separate state flowers in all. The table shows the flowers shared by two or more states.

THE KEY TO STATES AND THEIR FLOWERS



ALABAMA	*Goldenrod (37)*
ARIZONA	*Saguaro cactus (27)*
ARKANSAS	*Apple blossom (5)*
CALIFORNIA	*Golden poppy (34)*
COLORADO	*Columbine (12)*
CONNECTICUT	*Mountain laurel (15)*
DELAWARE	*Peach blossom (1)*
FLORIDA	*Orange blossom (26)*
GEORGIA	*Cherokee rose (9)*
IDAHO	*Syringa (31)*
ILLINOIS	*Violet (23)*
INDIANA	*Zinnia (10)*
IOWA	*Wild rose (7)*
KANSAS	*Wild sunflower (20)*
KENTUCKY	*Goldenrod (37)*
LOUISIANA	*Magnolia (13)*
MAINE	*Pine cone and tassel (36)*
MARYLAND	*Black-eyed Susan (24)*
MASSACHUSETTS	*Mayflower (8)*
MICHIGAN	*Apple blossom (5)*
MINNESOTA	*Moccasin flower (29)*
MISSISSIPPI	*Magnolia (13)*
MISSOURI	*Hawthorn (25)*
MONTANA	*Bitterroot (6)*
NEBRASKA	*Goldenrod (37)*
NEVADA	*Sagebrush (35)*
NEW HAMPSHIRE	*Purple lilac (18)*
NEW JERSEY	*Violet (23)*
NEW MEXICO	*Yucca flower (32)*
NEW YORK	*Rose (22)*
NORTH CAROLINA	*Amer. dogwood (3)*
NORTH DAKOTA	*Wild rose (7)*
OHIO	*Scarlet carnation (11)*
OKLAHOMA	*Mistletoe (21)*
OREGON	*Oregon grape (28)*
PENNSYLVANIA	*Mountain laurel (15)*
RHODE ISLAND	*Violet (23)*
SOUTH CAROLINA	*Carolina yellow jessamine (19)*
SOUTH DAKOTA	*Amer. pasqueflower (14)*
TENNESSEE	*Iris (17)*
TEXAS	*Bluebonnet (2)*
UTAH	*Sego lily (4)*
VERMONT	*Red clover (30)*
VIRGINIA	*Amer. dogwood (3)*
WASHINGTON	*Rhododendron (33)*
WEST VIRGINIA	*Rhododendron (33)*
WISCONSIN	*Violet (23)*
WYOMING	*Indian paintbrush (38)*
DISTRICT OF COLUMBIA	*Amer. beauty rose (16)*

AN ALL-AMERICAN BOUQUET

This lovely bouquet contains the official state flowers of the United States. It was prepared for the coronation of Elizabeth II of England in 1953 by Alyn Wayne of the Florists' Telegraph Delivery Association. The flowers and the states they represent are identified in the key on the opposite page.

STATE GOVERNMENTS. Midway between the far-reaching federal government and the local (county or municipal) government stands the state government. It has widespread legislative, administrative, and judicial powers that affect the lives of every resident in the state.

The governments of the original 13 states were already at work under their own constitutions when the United States Constitution was formed. Many of the framers of the Federal Constitution were men who had helped write their own state constitutions. In many ways the form of the national government is the product of experience in shaping state governments.

State powers, found in state constitutions, are largely based on the 10th Amendment to the United States Constitution: "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people." In addition, the Federal Constitution guarantees that each state be republican (representative) in its form of government and that each state extend the same "privileges and immunities" to citizens of other states that it gives to its own citizens.

Every state has a written constitution, for Congress will not admit a new state to the Union until it has formed an acceptable constitution. Some of these documents are long, some comparatively short, but all contain certain features. Practically every one has a Bill of Rights listing the rights which the state may not take away from the individual. In all of them there are provisions for the organization of the legislative, executive, and judicial departments with definitions of the powers and duties of each.

HOW THE STATES GOT THEIR NAMES

NAME	PROBABLE ORIGIN AND MEANING	POPULAR NAME
Alabama	From Choctaw words meaning "to pull or reap vegetation"	Yellowhammer State
Arizona	From Pima Indian word *ari-zonac*, meaning "little spring"	Grand Canyon State
Arkansas	Indian word meaning "downstream people"	Wonder State
California	Named by Cortez from a 16th-century Spanish novel, or from *caliento forno* ("hot furnace"), referring to Lower California deserts	Golden State
Colorado	Spanish word meaning "reddish or ruddy colored"; first applied to river	Centennial State
Connecticut	From Indian word *Quonektacut* ("long river"); first applied to river	Constitution State
Delaware	State, river, bay named for Lore do la Warr, first governor of Virginia	Blue Hen State
Florida	From *Pascua florida* (Flowery Feast) Spanish for "Easter Sunday"	Everglade State
Georgia	Named in honor of King George II of England	Empire State of the South
Idaho	From Shoshone Indian words meaning "Look, the sun is coming down the mountains!"	Gem State
Illinois	From Algonquian Indian *Iliniwek*, meaning "men." French changed ending to *ois*	Prairie State
Indiana	Formed by adding "a" to "Indian," meaning "Indian land"	Hoosier State
Iowa	Indian word of uncertain meaning; perhaps, "this is the place"	Hawkeye State
Kansas	Named for *Kansa* tribe of Sioux Indians, meaning "wind people"	Sunflower State
Kentucky	From Indian *Kentake*, meaning "meadow lands" or "prairies"	Bluegrass State
Louisiana	"Land of Louis," in honor of Louis XIV, king of France	Pelican State
Maine	First named "the Main" to distinguish it as mainland rather than one of the many coastal islands	Pine Tree State
Maryland	Named in honor of Queen Henrietta Maria of England	Old Line State
Massachusetts	Algonquian Indian words meaning "near the great mountain"	Bay State
Michigan	Probably from Algonquian Indian word meaning "great lake"	Wolverine State
Minnesota	Dakota Indian name meaning "sky-tinted water"	Gopher State
Mississippi	From two Indian words meaning "great river"	Magnolia State
Missouri	Algonquian Indian word meaning "town of the great canoes"	Show Me State
Montana	Latin word meaning "mountainous region"	Treasure State
Nebraska	From *Nebrathka*, Otoe Indian word meaning "shallow water"	Cornhusker State
Nevada	Uncertain origin; probably Spanish *nevada*, meaning "snow-covered"	Sagebrush State
New Hampshire	From the county of Hampshire in England	Granite State
New Jersey	Named for island of Jersey (Caesarea) in the English Channel	Garden State
New Mexico	From Nahuatl Indian name *Mexitli*, an Aztec divinity, plus co, meaning "place of"	Land of Enchantment
New York	In honor of the Duke of York, later James II of England	Empire State
North Carolina	Named for Charles I (Latin, *Carolus*), king of England	Tarheel State
North Dakota	Indian name for "allies"	Flickertail State
Ohio	Indian name meaning "fair and beautiful river"	Buckeye State
Oklahoma	From Choctaw Indian words meaning "red people"	Sooner State
Oregon	French, Indian, or Spanish word, first applied to river	Beaver State
Pennsylvania	Latin for "Penn's woods" (for father of founder, William Penn)	Keystone State
Rhode Island	Named for Island of Rhodes in Narragansett Bay; or possibly from Dutch *Roode Eylandt*, meaning "red island"	Little Rhody
South Carolina	Named for Charles I (Latin, *Carolus*), king of England	Palmetto State
South Dakota	Indian name for "allies"	Sunshine State
Tennessee	Named from Cherokee capital, *Tenassee*	Volunteer State
Texas	From Spanish form, *Tejas*, meaning "allies" or "friends"	Lone Star State
Utah	From Indian *Eutaw*, meaning "in the tops of the mountains"	Beehive State
Vermont	Named from French *vert mont* ("green mountain")	Green Mountain State
Virginia	Named in honor of the "Virgin Queen," Elizabeth of England	Old Dominion
Washington	Named in honor of George Washington, first U.S. president	Evergreen State
West Virginia	In honor of Elizabeth, "Virgin Queen" of England	Mountain State
Wisconsin	Ojibway Indian *Meskousing*, meaning "meeting place of waters"	Badger State
Wyoming	From valley in Pennsylvania where Wyoming Indian tribe once lived; means "large plains" or "large meadows"	Equality State

Finally there are provisions for amending and revising the constitution.

The State Legislature

In some states the legislative body is known as the *legislature*, in others as the *general assembly*. In a few it is called the *legislative assembly* or the *general court*. Nebraska has a one-house (*unicameral*) legislature; all others have a two-house (*bicameral*) system. Representatives in the lower house are elected from districts laid out according to density of population; senators in the upper house come from area-based districts. In actual practice, there have been many inequities in this system of representation (*see* Gerrymander).

The lower house is presided over by a speaker chosen by his fellow members. The presiding officer of the upper house is the lieutenant governor. The business of the state legislature is, of course, to make laws concerning a countless number of activities over which the state has control. A few of these are highways, wildlife, health, and licensing of trades, professions, vehicles, and corporations.

The Executive Branch

The chief executive officer in the state is the governor, elected by popular vote. His term may be either two or four years; in some states he cannot succeed himself in office. All the states except North Carolina give the governor a veto power similar to that given the president of the United States. Many states also give the governor an "item veto" power over appropriations bills. This means that he can veto certain expenditures and allow others to pass. In a few states he can reduce expenditures as well as veto them outright.

The governor is charged with enforcing the laws of the state. However, the officers through whom he executes this duty are largely elected by the people and are not directly responsible to him. Thus this provision amounts to little except in cases of emergency. Actually his main job is to originate legislation and by force of his position take steps to see that needed laws are passed by the legislature.

Other administrative officers of the state include the superintendent of public instruction, the board of medical examiners, auditor, state treasurer, attorney general, purchasing agent, and many others. Some are elected; others are appointed.

The State Courts

All the courts of justice below the federal level are called state courts, even though the lower state courts serve only a town, township, or county. Federal judges are always appointed, but in about three fourths of the states, the state judges are elected by popular vote. In some states candidates run on a nonpartisan ballot. In some of the states that permit gubernatorial appointment of judges, a popular referendum on these appointees is required after a period of service.

An important state legal officer is the prosecuting attorney, sometimes called state's attorney, county attorney, district attorney, or public prosecutor. In a few states he is appointed by the governor; in the rest he is elected by the voters of the district, usually a county, in which he is to function. (*See also* Courts of Justice.)

The Fact Summaries in each state article give important facts about each state government.

STATES' RIGHTS. When the American Colonies separated from Britain, at first each one became an independent government. The colonists soon realized that one nation would be far stronger than 13 separate states, and in 1787 they adopted a constitution which created the desired nation. To do this each state surrendered some powers to the central government to be exercised for the good of all.

Some people believed that this arrangement gave the central government power superior to that of the states in all matters entrusted to it. Others believed that the states which had formed a central government could also withdraw in whole or in part. In particular, many people believed that in cases where a national law conflicted with a state law, the latter should prevail. This amounted to claiming that a state could *nullify* a national law—that is, declare that the law should not be enforced within the state.

This doctrine first appeared in 1798, when the legislatures of Kentucky and Virginia protested against the Alien and Sedition laws (*see* Adams, John; Alien and Sedition Laws). During the War of 1812 the New England states were opposed to the conflict. They refused to obey President Madison's call for troops and even threatened to withdraw from the Union.

Later the Southern states supported the doctrine of states' rights to protect slavery against hostile national laws. They also opposed tariffs and other legislation urged by the North to promote manufacturing. In 1832 South Carolina declared that a high tariff of that year was "null and void" in the state. President Jackson's firmness and passage of a more moderate tariff ended the dispute for a time (*see* Jackson, Andrew). The Northern attitude was expressed in Jackson's toast—"Our Federal Union, it must be preserved"—and in Daniel Webster's statement, "Liberty and Union, now and forever, one and inseparable."

In 1860 and 1861 the Southern states took action to secede from the Union. The Civil War followed, and by force of arms the North compelled the Southern states to accept the view that no state could withdraw from the Union or resist lawful national authority (*see* Civil War, American).

Since the Civil War no one has thought that a state could secede from the Union or nullify a national law. "States' Rights" in that sense is dead. However, some still hold that as many rights as possible should be left to the states, and that in case of doubt as to whether a right has been granted to the federal government or retained by the states, it should be given to the latter. This concern for the states arose as a result of the enlargement of the power and activities of the federal government. Many feared that this enlargement would deprive the people of the control they should be able to exercise through their state government over affairs of local interest.

The Varied Data Collected by the Census Takers Are Used to Measure Statistically Many Changes in American Life

HOW *to* READ STATISTICS

STATISTICS. Anyone who listens to the radio, watches television, and reads books, newspapers, and magazines cannot help but be aware of statistics. Statistics appear in the claims of advertisers, in predictions of election results and opinion polls, in cost-of-living indexes, and in reports of business trends and cycles. Every science depends to some extent upon the gathering of data and the interpreting of the data by statistical methods. On the basis of statistics, important decisions are made in the fields of government, industry, and education. Even the average person bases many of his personal decisions on information that has been supplied by statisticians.

The term "statistics" is used in two different ways. When used in the plural, it refers to numerical data. For example, we would say: "Statistics *show* highway accidents to be caused by . . ." When used in the singular, it means statistical methods. For example, we would say: "Statistics *is* the body of principles and methods that has been developed for collecting, analyzing, presenting, and interpreting large masses of numerical data." Without statistical treatment of data, there would be no way to put the "facts" together to see what they mean.

The results of statistical investigations may sometimes be stated in a single sentence, as in weather forecasting. Usually, however, they are presented in the form of numerical tables, as in census reports, or are shown pictorially in the form of graphs or charts (*see* Graphs).

How Statistical Data Are Collected

Statistical data are usually collected in one of the following ways: (1) by consulting existing published or unpublished source material, such as periodicals and newspapers, or reports from industries, government agencies, and research bureaus; (2) by setting up a survey and collecting the data first hand from individuals or organizations; and (3) by conducting scientific experiments and measuring or counting under controlled conditions.

Basic information must be collected in such a way that it is accurate, representative, and as comprehensive as possible. Statistical treatment cannot in any way improve the basic validity or accuracy of the raw data. Methods of collecting data are therefore basic to the whole field of statistics.

Populations and Samples

The term *population* as ordinarily used means the whole number of people in a certain city, county, state, or nation. The statistician speaks of a population of automobiles, radio sets, salaries, accidents, ballots, blood pressures, or any other characteristic he may be interested in. For him a population—also called a *universe*—means the entire group of all possible items in the class he is considering.

Usually it is not possible to gather observations from all the possible cases in a population. Some

populations are infinite. For example, if one should want to count how many times "heads" will turn up when a penny is tossed, he would have to set a limit to the number of throws because even a billion would not exhaust the infinite universe of possible trials. Other populations, though finite, are so large that it would take too much time or cost too much to collect data on each unit in them. Every ten years the United States government conducts a census of the whole population of the United States; but this is a gigantic and costly undertaking (*see* Census). The statistician usually gets his information from a relatively small number of cases, called a *sample*. From the measurements or observations of the individuals sampled, he makes generalizations about the population from which the sample was selected.

The individuals in a sample must be *representative* of the larger population; otherwise the conclusions drawn from the sample would not be valid for the larger population. For example, one cannot draw valid conclusions about the probable outcome of a national election from interviewing a sample of 10,000 registered voters unless they are representative of the people who will actually vote later in the election.

The *size* of the sample is a factor also. Other things being equal, a larger sample is better than a smaller one. However, excellent results can be obtained with small samples that are properly set up.

Most public opinion surveys are conducted on samples that are made as representative as possible by means of *stratified* sampling techniques. For example, a national polling sample can be set up by first dividing the whole country into various geographical areas and then dividing each area into *strata* (layers) according to the degree of urbanization. The interviewers who go out to talk to people are assigned certain areas. Each interviewer is instructed to interview a certain specified number of people in certain categories, such as different socio-economic levels and different age groups. This is *quota sampling*. Its purpose is to make the proportions in the sample of interviewees the same as in the general population. Quota sampling results in remarkably accurate forecasts even though the actual samples are small as compared with the total population.

Basic to all sampling techniques is the idea of *randomness*. By this is simply meant that samples are drawn in such a way as to insure that any unit in the population is equally likely to be included. This is essentially what one does in shuffling a deck of cards preparatory to dealing hands of canasta or bridge. The dealer is simply insuring that any card or combination of cards is equally likely to end up in one hand as in another. Interestingly enough, much of the theory of sampling was developed from so-called games of chance. Random sampling is used a great deal in scientific experiments. Usually the cases to be included are selected by means of some device such as a table of random numbers.

Many sampling procedures are *loaded* in some way that may influence the results. For example, a sample of persons who volunteer for a study may or may not be typical of the whole group. It is sometimes found that people who send back questionnaires immediately give different replies from those who send them back after several follow-up letters. Opinions expressed in "letters to the editor" on current issues would also be nonrandom and nonrepresentative samples.

Two Kinds of Data—Discrete and Continuous

The types of data that can be handled statistically occur in one of two forms. One kind is obtained by counting. The other is obtained from measurements.

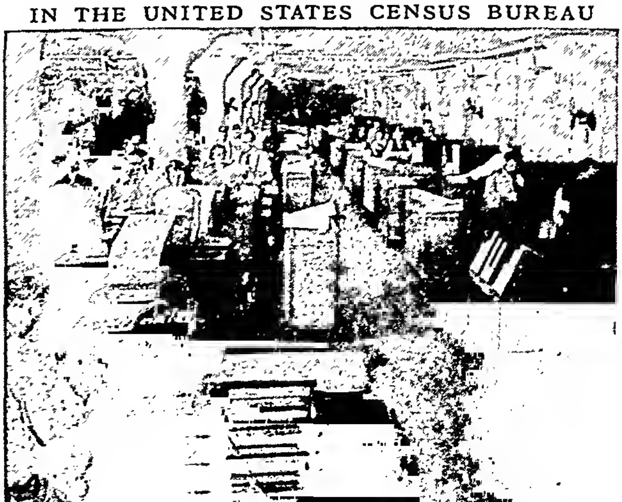
Discrete Data. Numbers obtained by counting a small group—such as the members of a family—are exact. If another child is born, the number leaps from three to four without passing through any intermediate stages, such as $3\frac{1}{2}$. A succession of such numbers is called a *discrete*, or *discontinuous*, series.

Suppose a market research analyst wants to study the preferences of consumers for certain types of breakfast foods, radios, automobiles, or cigarettes. To collect the data, he might ask a number of people to state their brand preferences; or he might check on what brand of cigarettes they smoke or what kinds of breakfast food they have on their kitchen shelves. The *categories* will be expressed by a word or a phrase, and the data will be an exact count or enumeration of the number of cases in each category.

When graphed, discrete data are usually represented by bars separated from one another to suggest the discontinuity between the categories (*see* Graphs).

Continuous Data. The second type of data consists of measurements that fall along a continuous scale, such as distance in feet and inches, weight in pounds, temperature in degrees, time in minutes, hours, or years, and grades made on examinations. The measurements are usually obtained by using some sort of measuring instrument, such as a ruler, a scale, a thermometer, or a school test. This type of data is called *continuous*, because all gradations are possible between the lowest and highest in the series. The classes are expressed numerically rather than with

IN THE UNITED STATES CENSUS BUREAU



Punched cards are sorted automatically into many desired classes. High-speed tabulating machines count up the totals.

a word or phrase and are not definite and distinct from one another.

Some types of data can be expressed as either discrete or continuous. For example, measurements of intelligence are frequently expressed in terms of "average," "bright," and "dull" instead of in numerical scores, which fall on a continuous scale. Psychological test scores are often expressed in terms of age norms or grade norms. A time series also may be expressed as a discrete series, as in the United States Census, which is taken at ten-year intervals. Actually, of course, the population changes are gradual.

The Reliability and Validity of Measurements

It is possible to be 100 per cent accurate when counting a small group. Even in counting, however, errors occur if the numbers handled are large. Measurements, on the other hand, are never 100 per cent accurate; there is always some residual error that cannot be eliminated. Generally, however, they are sufficiently accurate and dependable if the measuring instrument itself is accurate (that is, has been calibrated properly) and the person using the instrument is a skilled observer and a careful recorder.

The *reliability* of a measuring instrument or of a test refers to how consistently it measures something. A reliable watch will show the same time from one day to the next day (that is, every 24 hours) even though it might always be a little fast or a little slow as compared with "correct" time. An *accurate* watch, on the other hand, gives correct time (within certain limits) according to some standard, such as that of the Naval Observatory. Likewise, an accurate thermometer is one that shows the correct temperature (within very close limits) so that one does not have to add or subtract a certain number of degrees to arrive at a correct reading.

The *validity* of a measuring instrument refers to whether or not it measures what it is supposed to measure. A thermometer is a valid instrument for measuring temperature; but one does not use it to measure humidity, wind velocity, time, or distance.

For public opinion polling on political issues, the measuring device has to be built. This measuring device is called a *questionnaire*, or *interview schedule*. Usually it consists of a series of printed questions with spaces for writing in the answers to the questions which the interviewer asks. Poorly written questions that the interviewee does not understand lead to worthless information. In order to guard against this, a great deal of time is spent in perfecting the questionnaire before the survey is begun. The interviewers are carefully selected and are trained to secure and record the basic information, since they too could be a great source of error. Statistical treatment cannot overcome poor wording in questionnaires, poor interviewing, or inaccurate recording any more than it can compensate for poor instruments in other types of research.

Frequency Distribution Tables

The statistician works with large masses of data. Before he can draw any conclusions from such data, he must condense it and arrange it in usable form. Almost all tabulations that one sees are *grouped* in one way or another. The easiest way to summarize and describe a mass of statistical data is by means of frequency distribution tables and charts.

Table I lists average grade-level reading scores made by a group of 88 sixth-grade students. The scores have not been arranged in any order. It is extremely

TABLE I

Average Grade-Level Scores Made by a Group of 88 Sixth-Grade Students on a Standardized Reading Test (Stanford Achievement)

5.9	6.2	5.2	7.3	6.6	9.6	7.8	6.5
7.5	8.4	6.4	6.8	6.3	8.4	6.0	9.8
5.5	5.4	6.5	9.6	8.9	5.4	7.6	4.1
8.8	7.0	7.7	8.4	7.5	7.0	4.8	7.7
5.1	8.8	7.4	9.1	8.1	3.6	6.4	5.0
5.8	9.3	7.4	9.2	6.7	8.4	6.3	7.9
4.7	6.6	7.6	8.1	7.7	6.7	11.2	5.1
8.5	5.0	10.4	6.8	7.4	8.1	6.8	8.5
6.2	8.1	8.1	10.1	8.7	7.3	4.3	7.2
9.0	7.9	9.2	4.9	8.4	6.2	8.6	5.7
9.6	8.1	9.2	7.6	11.0	6.8	6.7	8.9

TABLE II

Unit Frequency Distribution of Average Reading Scores

Grade Score	f	Grade Score	f	Grade Score	f
11.2	1	8.6	1	6.0	1
11.1		8.5	2	5.9	1
11.0	1	8.4	5	5.8	1
10.9		8.3		5.7	1
10.8		8.2		5.6	
10.7		8.1	6	5.5	1
10.6		8.0		5.4	2
10.5		7.9	2	5.3	
10.4	1	7.8	1	5.2	1
10.3		7.7	3	5.1	2
10.2		7.6	3	5.0	2
10.1	1	7.5	2	4.9	1
10.0		7.4	3	4.8	1
9.9		7.3	2	4.7	1
9.8	1	7.2	1	4.6	
9.7		7.1		4.5	
9.6	3	7.0	2	4.4	
9.5		6.9		4.3	1
9.4		6.8	4	4.2	
9.3	1	6.7	3	4.1	1
9.2	3	6.6	2	4.0	
9.1	1	6.5	2	3.9	
9.0	1	6.4	2	3.8	
8.9	2	6.3	2	3.7	
8.8	2	6.2	3	3.6	1
8.7	1	6.1			

difficult to make any judgment on the basis of these figures except to say that relatively few of the sixth graders are at sixth-grade level (scores 6.0 to 6.9) in their reading ability. It would be impossible, using this haphazard arrangement, to answer readily any of the following questions:

1. What is the range in reading ability among these students, from highest to lowest?
2. How well do they read as a group?
3. What is the average grade-level score?
4. Do the scores seem to cluster at one or two grade levels or are they scattered rather widely?
5. What proportion is retarded? What proportion is accelerated?
6. What range of scores includes the middle half?
7. How would a pupil with a grade-level score of, say, 6.5 compare with the rest of the group?

In order to make such data usable, the statistician ordinarily groups it into classes. This has been done in Table II. All the possible scores, from the highest to the lowest, are written in the "stub." The stub is the vertical column at the left (Grade Scores).

In the next column are tabulated the number of times each score occurs. Technically, this number is called the *frequency*. (The letter *f* means frequency in statistical work.) The tabulating was done by taking each score shown in Table I and placing a tally mark (/) opposite that score value in Table II. The tally marks were then changed to numbers. Notice

TABLE III

Frequency Distribution of Average Reading Scores Tabulated to Nearest Grade Level

Score Interval	Grade Level*	f
10.5-11.4	11	2
9.5-10.4	10	6
8.5-9.4	9	14
7.5-8.4	8	22
6.5-7.4	7	19
5.5-6.4	6	12
4.5-5.4	5	10
3.5-4.4	4	3
	N=	88

*Mid-point of class interval

TABLE IV

Reading Status of a Group of Pupils in the Sixth Grade

Accelerated	63	71%
At Grade	12	14%
Retarded	13	15%
	N=88	

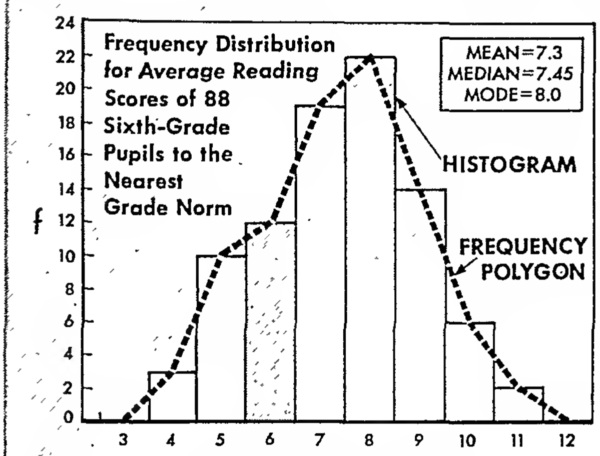


FIG. A

that some scores did not occur at all and others occurred more than once.

Table II gives us some important information. It shows that the reading ability of these sixth-grade pupils varies from 3.6 (third-grade level) to a grade level of 11.2. The range between 3.6 and 11.2 is wide —7.6 grades. Now it is easy to determine the proportion of pupils who are accelerated (read better than the sixth-grade level) and the proportion who are retarded (read not as well as sixth-grade level). We simply count the cases above and below sixth-grade level and find that approximately 60 per cent are accelerated and 20 per cent are retarded. It is clear that as a whole the group reads well.

Table III is further condensed by grouping the classes to the nearest grade level. Thus all scores representing sixth-grade reading ability—from 5.5 through 6.4—are put together. These two figures are called the *class limits* and the distance between them is called the *class interval*. Notice that all the class intervals are the same size.

One should remember that when a grouped frequency distribution is used, all information about specific individuals is lost. The unit classification in Table II is more precise; but the class interval is usually preferred because it shows more clearly the over-all pattern of the group.

Table IV is a summary made from Table III. It shows the data arranged in three groups according to *categories* which describe reading ability.

Frequency Distribution Graphs

Fig. A shows Table III graphed in two ways. At the left is the frequency scale. Above each class interval a line is drawn on the horizontal scale at a level corresponding to the frequency of that interval. The resulting stair-step pattern is called a *histogram*. Connecting the centers, or mid-points, of the class intervals by straight lines produces a *frequency polygon*. Notice that the frequency polygon gives the impression that the class intervals are continuous. Even a casual examination of either of these curves gives some idea of the general characteristics of the distribution. (*See also* Graphs.)

In statistics considerable attention is paid to the form of such curves. The distribution is said to be *bilaterally symmetrical* if it can be folded vertically so that the two halves of the curve are essentially the same. If the curve is lacking in symmetry, the distribution is said to be *skewed*. The so-called "normal" curve has a bell shape and is perfectly symmetrical. (*See* Individual Differences.)

Measures of Average, or Central Tendency

The statistician uses frequency tables to carry on further computations. Usually he seeks to find some one number that will represent all the data in some definite way. One method of summarizing data is to calculate the average of the group. The statistician uses three kinds of averages. Each kind represents the group in a different way.

Arithmetic Mean. The measure of central tendency most commonly used by statisticians is the same measure most people have in mind when they use the word "average." This is the arithmetic average, called by statisticians the *arithmetic mean*, or simply the *mean*. It is obtained by adding together all the scores or values and dividing the resulting sum by the number of cases (N). It can be calculated from either the original measures or the grouped data. Using the grouped grade-level scores in Table III, the mean is found to be 7.3, which shows acceleration.

Mode. The *mode* (also called *modal average*, or *norm*) is a rather rough average, but it is useful because it represents the most frequent or typical measure. The *crude mode* is defined as the mid-point of the class interval that contains the highest frequency or as the score or measure that occurs the greatest number of times. In Table III the interval 7.5 to 8.4 has the highest frequency (22). The mode is a grade level of 8.0, the mid-point of this interval. We see that the modal reader in this group of sixth-grade pupils is accelerated in reading. If the pupils were a typical sixth-grade group, we should expect the mode to be at grade level.

Median. The *median* is defined as the middle score in a series of values arranged in order of magnitude. Above the median are to be found 50 per cent of the cases and below it are to be found 50 per cent of the cases. To find the median in the 88 cases of Table III, we simply count down or up to the 44th and 45th cases and take the mid-point between them. This is halfway between 7.4 and 7.5, or 7.45. Half the pupils scored above 7.45 and half below. The typical pupil in this sixth-grade group, then, reads on a seventh-grade level.

Usually the measures of central tendency are near the middle of the entire distribution, hence the name. As scores deviate more and more from the central tendency, they become less frequent. An average serves as a sort of standard of comparison by means of which one can judge whether a score is common (typical) or whether it is relatively unusual (rare or atypical). In some distributions the scores or measures tend to pile up at one end or the other instead of in the middle. Such distributions are described as *skewed*. Other distributions appear to have more than one mode, indicating generally that two or more types of data have been thrown together into one distribution. These distributions are described as *bimodal* or *multimodal*.

Percentile Rank

The most common method of reporting results on educational and psychological tests, along with age and grade norms, is by *percentile rank*.

Table II shows that two pupils had a score of 6.5. These pupils are *below average* as compared with the rest of their classmates. (Note, however, that they are actually reading at sixth-grade level and are not retarded.) The score 6.5 is better than only 28

TABLE V

Distribution of Mechanical Aptitude Test Scores for Technical-School Graduates and Nongraduates

Aptitude Scores	Frequency		
	Graduates	Non-graduates	f Combined
95-99	6		6
90-94	9		9
85-89	20	1	21
80-84	23	4	27
75-79	18	7	25
70-74	8	19	27
65-69	5	17	22
60-64	1	24	25
55-59		18	18
50-54		15	15
45-49		6	6
40-44		4	4
N=	90	115	205

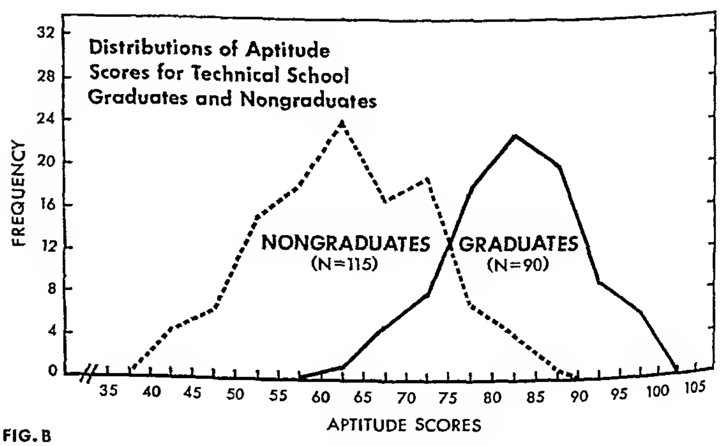


FIG. B

per cent of the group. This can be expressed by stating that the *percentile rank* of these pupils is 28 (that is, this score is higher than that made by 28 per cent of the group). Although these two students read at the expected grade level (sixth), they are actually poorer readers than the majority of their classmates. The mean is the 50th percentile.

Measures of Variability, or Dispersion

Two distributions may have averages that are exactly alike, yet there may be little or no variation in one and great variation in the other. For example, the arithmetic mean for the two distributions below is 4; yet in the second series the variation is zero.

1 2 3 4 5 6 7 4 4 4 4 4 4 4

This example shows the need for a measure that will tell whether the data cluster closely about the average or are scattered widely. Variability, like averages, is described by the statistician with a single number in order to make it easier to compare dispersions. Several measures of variability have been devised.

Range. The simplest measure of variability is the *range*—the difference between the highest and the lowest items in the sample. In Table II the range is 7.6 grades—the distance from the highest grade level, 11.2, to the lowest, 3.6. The chief difficulty with the range as a measure of variability is that extreme scores are given too much importance.

Interquartile Range. When central tendency is measured by the median, percentiles may be used to indicate the spread. The *interquartile range* includes the middle 50 per cent of the cases. It is found by determining the point below which 25 per cent of the cases fall (the 25th percentile, or first quartile) and the point above which 25 per cent fall (the 75th percentile, or third quartile). The difference between these two values measures the middle 50 per cent of the scores or measures. In Table II the interquartile range is 2.1 (the difference between 8.4 and 6.3).

Statisticians more commonly use half this distance as their measure of variability. This is called the *semi-interquartile range*, or the *quartile deviation*. In this example it would be 1.05.

Average Deviation. The *average*, or *mean, deviation* is obtained by subtracting each score from the mean score and averaging the deviations—disregarding the fact that some are plus quantities and some are minus. The obtained value can be interpreted as a measure of how much the individual scores deviate, on the average, from the mean. The larger the average deviation, the greater the variability (heterogeneity).

Standard Deviation. The best measure of variability is the *standard deviation*. Like the average deviation, it is based on the exact deviation of each case from the mean. The deviations, however, are squared before being added. Then the sum is divided by the number of cases and the square root is extracted. In the series of numbers 2, 4, 7, 7, 8, 9, 12, 15, 17, the mean is 9 (81 divided by 9). The standard deviation

TABLE VI

SUMMARY TABLE

Comparisons of Technical School Graduates and Nongraduates on Aptitude Tests Results

Statistical Results	Graduates	Nongraduates	Combined Group
N	90	115	205
Measures of Central Tendency:			
Mode	82	62	—
Median	82.4	62.6	71.9
Mean	82.2	62.7	71.2
Measures of Variability:			
Total Range	(63-99) 36	(41-87) 46	(41-99) 58
Interquartile Range	10.5	14.7	24.2
Quartile Deviation	5.3	7.3	12.1
Standard Deviation	7.8	9.8	13.2
Percentage Exceeding Mean of Total Group	90	15	

is 4.6. This can be verified by performing the operation described above.

Comparing Two Groups of Similar Data

The data so far presented consist of a single measurement for one group. Frequently it is desirable to compare two groups with regard to a single measure.

Suppose we are interested in selecting better students for a technical school with the aim of decreas-

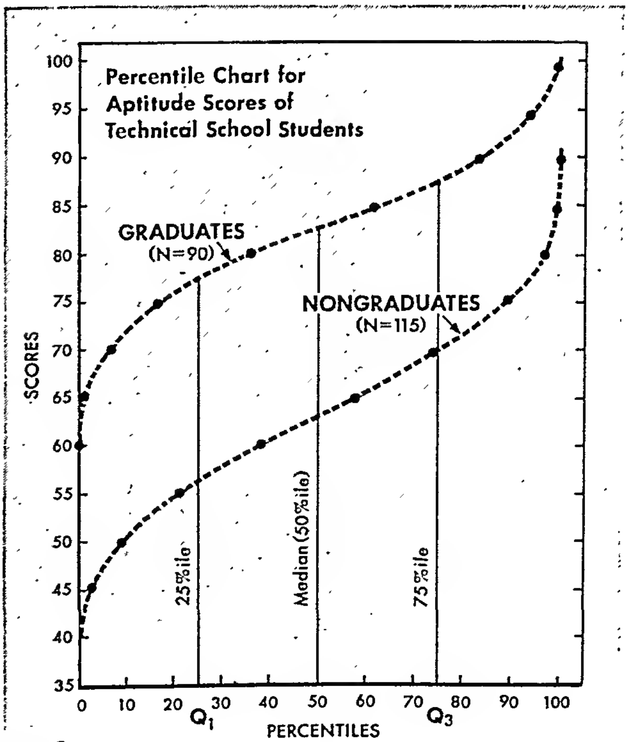


FIG. C

ing the proportion of students who fail or diop out before they finish the course. It is decided to give all entering students a mechanical aptitude test and then follow up later on to see whether the test actually predicts anything about success in the school.

Table V shows the results which might have been obtained in such a study. The *criterion* of success is simply graduation. Before definitely deciding to use the aptitude test for selection, however, we need to study the averages and variabilities of the two groups.

Table VI shows very clearly that the students who graduated had a higher average score than those who did not. This is true whether one compares the modes, the medians, or the means. Note that 90 per cent of the graduates exceeded the mean for the total group, while only 15 per cent of the nongraduates exceeded it. Another important finding is that, while there is considerable variation in each group, there is greater variability among the nongraduates than among the graduates. There is even greater variation, of course, in the combined group, due to putting two dissimilar groups together. Had there been no relationship between the aptitude test scores and graduation, the averages and variabilities of the two groups would not only have been very similar, but similar to those of the combined group as well.

Fig. B shows two simple frequency polygons on the same chart. Fig. C shows the two distributions in terms of *cumulated* percentage frequencies. The vertical distance between the two curves shows that the graduates are distinctly higher in performance than the nongraduates all along the line. Any score equivalent (such as the median score, or 50th percentile) can be obtained by running up from the percentile scale to the curve and across to the score scale. Fig. C actually constitutes a set of norms for this test, because any applicant's score can be evaluated in terms of how he compares with either group.

Measures of Relationship

When data are obtained for two or more traits on the same sample, it may be important to discover whether there is a relationship between the measures. Some typical problems are: To what extent do height and weight go together? Can one judge a person's intelligence from any physical characteristic? Is personality related to job success? Knowing a person's age, how well can one predict his reaction time? How consistent are repeated measures of achievement in school? Is income related to how far a person went in school? Can one predict a person's reading comprehension from how fast he reads or how many words he knows?

These questions are examples of *correlation* (relationship) problems. In every case there has to be a *pair* of measurements for each person in the group before we can measure the correlation. For example, if we wish to determine the correlation between height and weight for high-school boys, we have to know each boy's height and weight. By tabulating each pair of measurements on a *scattergram*, or *scatter diagram*, we can get an idea of the correlation visually.

Fig. D, a scatter diagram, shows the paired grade-level scores on a test of paragraph meaning and a test of word meaning for a group of sixth-grade pupils. The vertical axis (y) is laid off in terms of grade level for the paragraph-meaning test scores. The horizontal axis (x) is laid off in terms of grade level for the word-meaning test scores. Each tally mark represents both scores for one pupil. For example, one pupil scored 8 on word meaning and 5 on paragraph meaning. His two scores are represented by a single tally mark placed in the square that is directly above the 8 on the horizontal scale and across from the 5 on the vertical scale.

In the contingency table (VII), the scores are condensed into class intervals and numerals take the place of tally marks.

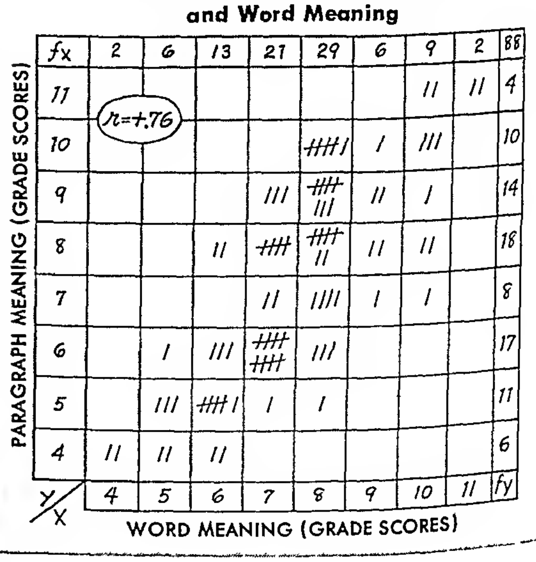
On both the scatter diagram and the contingency table, the scores tend to fall into a straight band that rises from left to right. It is evident that there is a decided trend for higher scores on paragraph meaning to go with higher scores on word meaning. This is called *positive correlation.* Note, however, that the correlation is not perfect. For example,

TABLE VII

Contingency Table Showing the Relationship Between Grade-Level Scores on Paragraph Meaning and Word Meaning

Paragraph Meaning	Word Meaning 4-5	6-7	8-9	10-11	Total
10-11			7	7	14
8-9		10	19	3	32
6-7	1	15	8	1	25
4-5	7	9	1		17
Total	8	34	35	11	88

FIG. D Relationship Between Scores on Tests of Paragraph Meaning and Word Meaning



ten pupils who scored at sixth-grade level for paragraph meaning scored at the seventh-grade level for word meaning (Fig. D).

Occasionally one runs across examples of *negative correlation.* This means that higher scores on one variable tend to go with lower scores on the other variable. *Zero correlation* indicates no relationship; knowing a person's score or rank on one variable would not enable one to predict his score on the other variable.

The statistician is not satisfied to indicate correlation in a general way but wants a single number that will show the amount of relationship. This precise measure involves the calculation of the *correlation coefficient* (r), which expresses the actual degree or intensity of relationship numerically. The correlation coefficient runs from −1:00 (perfect negative correlation) through 0:00 (zero correlation) to +1:00 (perfect positive correlation). The method of obtaining the correlation coefficient is beyond the scope of this article.

High correlations—whether positive or negative—are extremely important because they enable statisticians to make accurate predictions. Zero correlations—which will not predict anything—are also important. They may show, for example, that one cannot judge a person's intelligence from his head size or his honesty from the distance between his eyes. In both cases the correlation is close to zero between the *predictors* (head size or interpupillary distance) and the *criteria* (intelligence or honesty).

The size of the correlation coefficient as computed for the data shown in Fig. D is +.76. Since this correlation is not extremely high, one should be cautious in predicting one variable from the other. The two tests are related to a considerable degree; but good paragraph comprehension in reading does not necessarily mean equally good vocabulary, nor does a good vocabulary necessarily mean equally good paragraph comprehension.

Index Numbers

The most common use of index numbers is to express relative changes over a period of time in such quantities as prices, employment, income, and production. This relative change is expressed by showing one variable as a percentage of a *base.* Suppose an article that last year cost 25 cents now costs 27 cents. We may say (1) the price has risen 2 cents; (2) the article costs 8 per cent more; or (3) the *index price*—if we take last year as the *base*—is 108. The number 108 is a percentage of the price in the base year. This percentage is called an *index number,* or simply an *index.* The price in the base year is always stated as 100 per cent and the index numbers are computed relative to it.

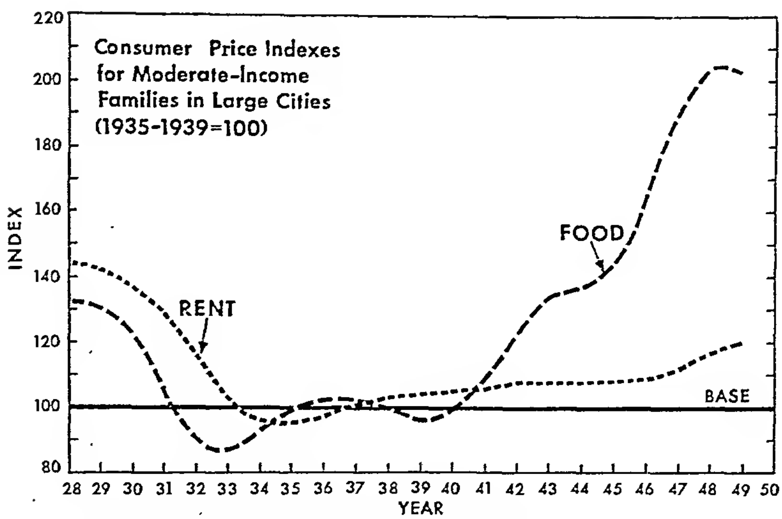


FIG. E Source: 1950 Statistical Abstract of the United States

Of course, for such a simple comparison as this we do not need an index number. Index numbers are used when we deal with a mass of figures and want to show relative changes over a considerable period of time. For example, there is no way of comparing an increase in the price of food with an increase in rents unless we express each as a percentage of some fixed value. Most business indexes use a period of relative economic stability as the *base period.* The period may be a single year or an average taken over a period of years. The individual items are usually *weighted* in proportion to the quantities or amounts that are produced, manufactured, or sold.

Fig. E shows figures for food and rent for the period 1928-49 for moderate-income families in large cities. (The original figures have been smoothed by using a three-year moving average.) The base period (100 per cent) is 1935-39. Indexes above 100 mean higher prices as compared with the base period. Indexes below 100 mean lower prices. These two indexes are combined with other indexes to form the over-all *Consumer Price Index* (*see* Living Costs). Another important price index is the *Wholesale Price Index,* which measures average changes in commodity prices as charged by manufacturers or producers to their customers.

Fig. E is a *time series graph* (*see* Graphs). It was constructed by plotting the index numbers for each year on the vertical percentage scale and then smoothing the curves. Since 100 is the base line, the trend downward before the war and upward after the war is clearly brought out. Owing to rent controls, the rent index did not rise as high as the food index.

Books about Statistics

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Croxton, F. E. and Cowden, D. J. Applied General Statistics (Prentice-Hall, 1940).
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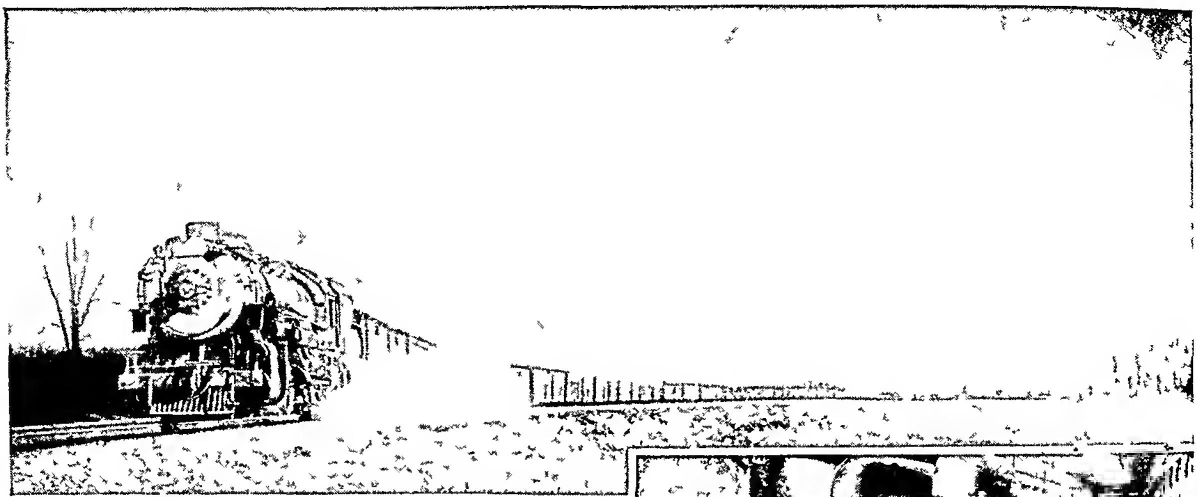
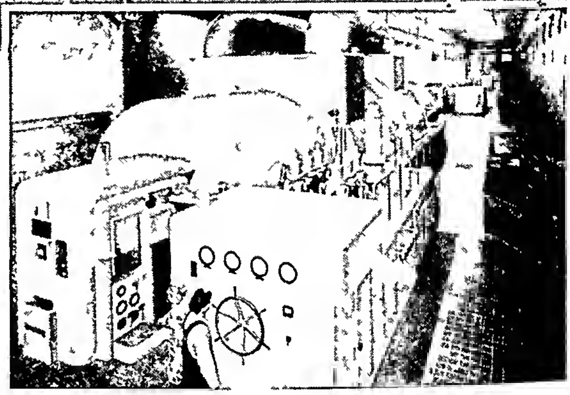
HARNESSING *the Tremendous* POWER *of* STEAM





Many railroads have Diesel-electric locomotives, and some lines use electric power But steam engines still do most of the pulling on the world's railroads The great majority of communities also owe their electricity to steam It comes from generators driven by steam turbines A generating plant is shown at the right.

STEAM ENGINE. Today we run automobiles with gasoline and use electricity for much of our light and power. Many people rarely see a steam engine at work. But steam engines are still highly important to civilization. Steam locomotives do most of the pulling on the world's railroads; and a large part of the electricity in use today is generated with power developed by steam turbines.

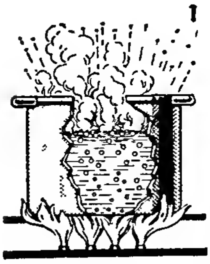
About two centuries ago the steam engine brought into being our modern Machine Age by providing a means for getting abundant power from heat. Inventors and businessmen used this power to develop large-scale factories for making goods cheaply. Railroads and steamships began hauling goods and passengers swiftly and cheaply. All this brought about reduced hours of work and tended to raise the standard of living in all civilized countries (*see* Industrial Revolution). It also led to further developments such as gasoline motors and electric light and power.

Why Steam Can Do Work

All this was possible because steam has immense *explosive power*. We might not think so, watching the white vapor commonly called steam as it drifts from a pot or kettle on the kitchen stove. But this is really water vapor, partly condensed into tiny droplets.

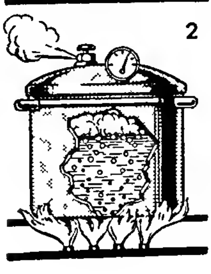
HOW STEAM POWER IS CREATED AND PUT TO WORK

1



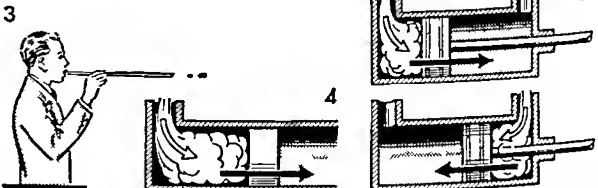
1. When water is heated until it boils, every particle (or *molecule*) in the liquid gains tremendously speedy motion. Some particles escape directly from the surface. Others form bubbles and fly free when the bubbles rise to the surface. The escaping molecules form the vapor called steam.

2



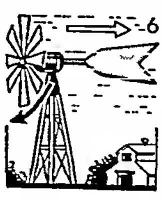
2. In a closed container such as a pressure cooker fast-flying molecules of steam constantly bump into each other and the inside surface of the container. The combined blows from all the molecules exert *pressure* If the steam is led from the container through a pipe, it will exert pressure wherever the pipe leads.

3 4 5

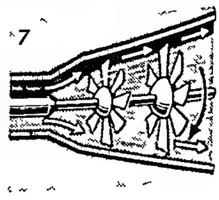


3 A boy can use his breath to blow a pea or a bean through a peashooter or bean blower. 4 If steam is admitted to a cylinder which is closed at the ends, its pressure can drive a disk (or *piston*) along the cylinder 5 If steam pressure is applied, first to one side, then the other, of the piston, the piston will move back and forth in the cylinder. This back-and-forth (or *reciprocating*) motion may be applied through a piston rod to drive machinery.

6



7



6 Wind can give power by driving a windmill. 7 Steam can be harnessed similarly by using vanes in a cylinder. An engine built on this plan is called a *steam turbine*. It gives *rotary* motion.

"Working steam" is invisible, like air; and it can expand with almost explosive force.

Steam has this expansive power because it is made up of fast-flying water molecules. Each molecule has gained speed enough from being heated to break loose from water and fly about freely. If it could move without striking anything, it might travel the better part of a mile in a second. Actually, steam particles do bump into each other, millions of times a second, and tend to spread apart at terrific speed.

If steam is held in a closed container, the blows from billions of particles add up to *pressure* upon the walls of the container. This pressure can be made to give power, as shown in the diagrams on these pages. It can be used against a piston to give *reciprocating* (back-and-forth) motion or in a turbine to give rotary motion.

Different Kinds of Boilers

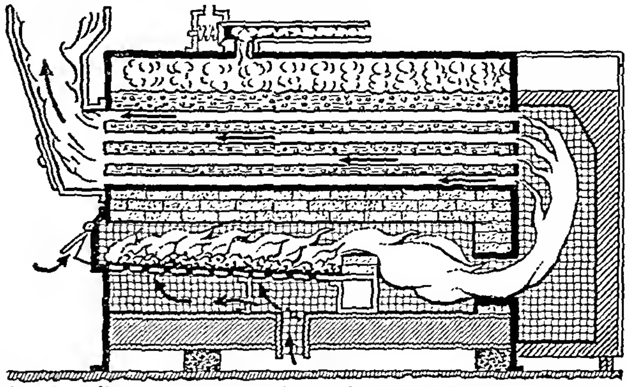
Every steam engine needs a boiler to make steam from water. In order to generate steam fast enough to supply the engine, most boilers have tubes, either *fire* tubes or *water* tubes. These provide a large area of heating surface.

Early boilers and engines had to change about 30 pounds of water to steam every hour to supply one horsepower. Modern types do better, although efficiency varies widely according to type. Fuel consumption can be reduced by *preheating* water, and perhaps air for the fire, with heat from exhaust steam.

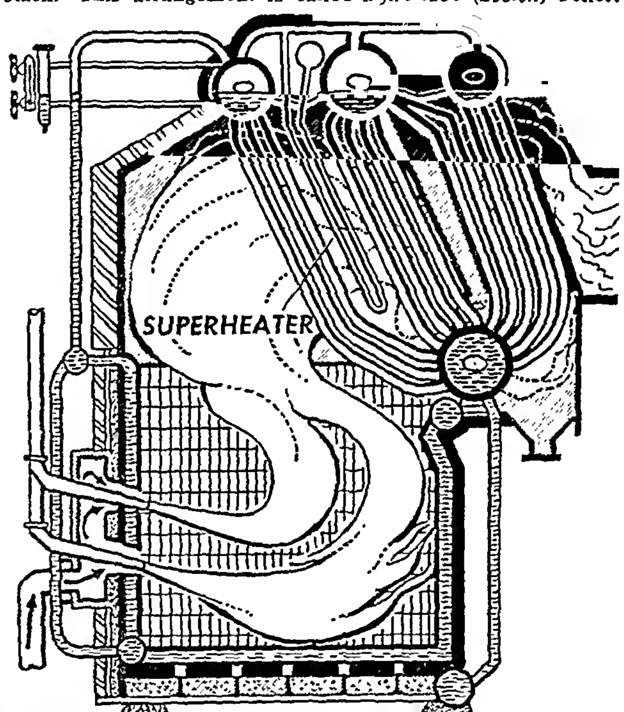
Considerable advantage is obtained from *superheat.* Since increased temperature is needed to produce steam when the overlying pressure is high, early boilers could barely keep high-pressure steam *saturated*—that is, free from condensed water vapor—as it expanded and cooled while working through the engine. By passing steam through tubes surrounded by fire, it can be superheated several hundred degrees. Then its expansion while working the engine will not cause condensation and loss of power. Superheat gave American locomotives about one third more power for the same weight and helped other types similarly.

Since most water contains minerals which form scale in or around boiler tubes, a *water purifier* may be needed. A boiler also needs an *injector* of some kind

IMPORTANT KINDS OF BOILERS

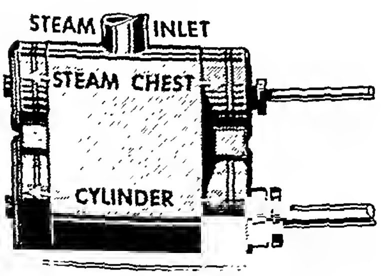


Steam boilers have many tubes to increase the area where fire can heat water. In the type of boiler shown above, the tubes carry hot gases from the fire through the water to the smokestack. This arrangement is called a *fire-tube* (*Scotch*) boiler.

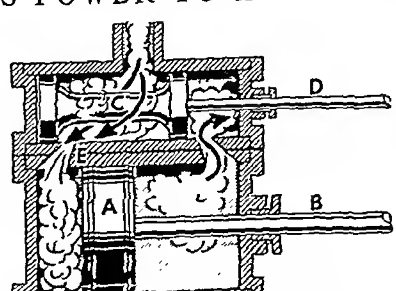


In this type of *water-tube* boiler, the tubes hold water and the hot gases pass around them. This arrangement provides intense heating and generates high-pressure steam quickly. The steam also passes through the coils of a *superheater*. This increases its energy, as explained in the article.

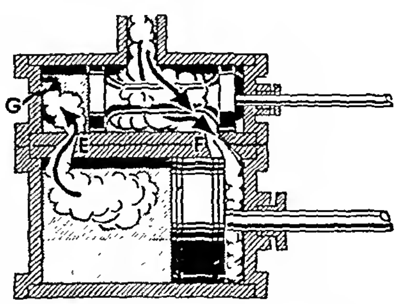
HOW STEAM GIVES POWER TO A RAILROAD LOCOMOTIVE



The most common reciprocating engine is a railroad steam locomotive. Steam is used to give power in the parts shown here. They are mounted in a metal jacket ahead of the driving wheels. An inlet pipe admits steam from the boiler to a cylindrical *steam chest*. From the chest the steam enters a *cylinder* through openings called *ports*.



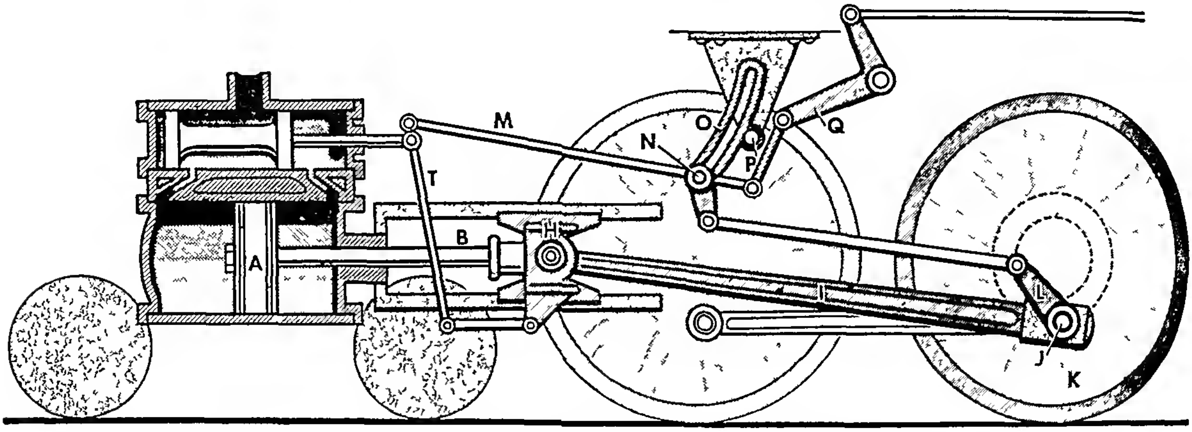
Inside the cylinder are a disklike *piston* (A) and a *piston rod* (B). Inside the steam chest is a double-ended "piston type" of *valve* (C). A *valve stem* (D) can shift the ends of the valve from side to side past the ports. Here the valve is admitting steam to the left side of the piston through port (E). This drives the piston and piston rod to the right.



Here the piston is at the right-hand end of its stroke, and mechanism not shown here has drawn the valve stem and valve to the right. Now steam passes through port (F) and starts driving the piston to the left. Meanwhile the valve shift lets the steam already at the left of the piston escape through port (E) and an *exhaust port* (G) to the smokestack.

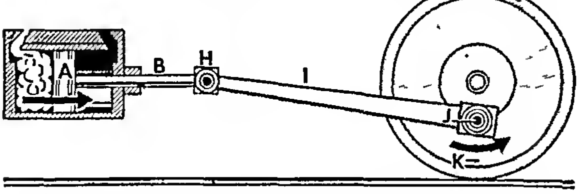
THE WORKING PARTS OF A STEAM LOCOMOTIVE

The diagram below shows the parts of a locomotive which apply steam power to turn the wheels and other parts which shift the valves. The various actions can be followed by tracing one step at a time. The most important parts are shown more strongly than others. They are also identified by letters which will be used throughout the explanations. (Some parts have been identified and given letters in diagrams on a previous page.)

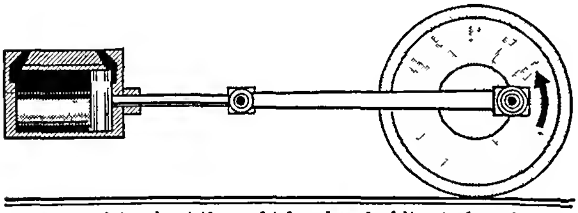


Note.—The action shown in the diagrams below for the drive (left) and valve shifting (right) occur together in actual operation to make a complete step. They are shown separately to avoid one complicated diagram.

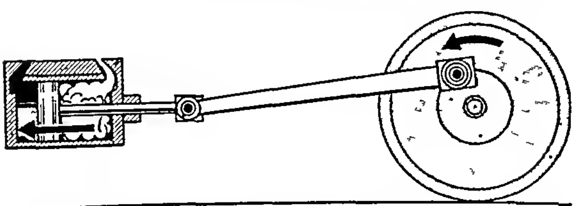
HOW STEAM POWER TURNS THE WHEELS



For simplicity, only essential parts are shown above. At the left is a cut-open cylinder with a piston (A) and piston rod (B). Steam is entering at the left and driving the piston and piston rod to the right. The rod passes the motion through a *crosshead* (H) and a *driving* (or *main*) rod (I) to a pivot called a *crankpin* (J) on one spoke (K) of a driving wheel. The spoke acts as a *crank* to turn the wheel.

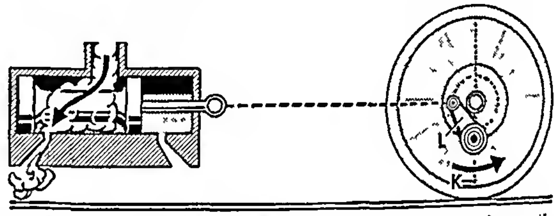


Here the piston is at the right-hand end of its stroke. At that moment, the driving rod is on *dead center,* in line with the piston rod. In this position it cannot turn the wheel. But the motion of the locomotive will take the rod past dead center, and it can start turning the wheel once more. At about this instant the valve shifts and admits steam to the right-hand side of the piston to supply power.

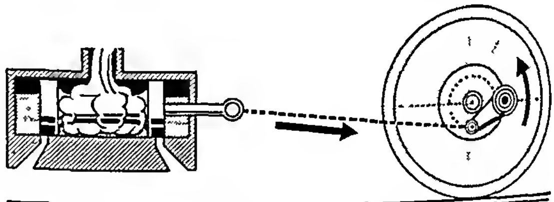


Here steam in the right-hand side of the cylinder is driving the piston to the left. The motion is passed on through the connecting parts to turn the wheel as shown. Thus the *reciprocating* (back-and-forth) motion of the piston is turned into *rotary* motion of the wheel by the crank action of spoke (K) and the wheel helps to roll the engine forward.

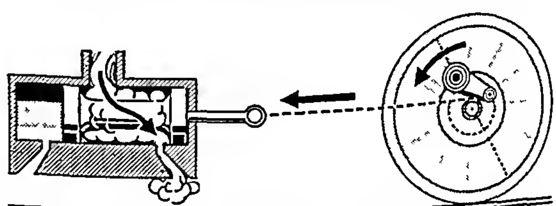
HOW GEARING SHIFTS THE VALVES



For simplicity in this diagram the valve is shown in line with the driving wheel. Several parts are indicated as a single rod (dotted lines) to avoid complication in showing the esseotial action of valve shifting. The shifting starts from the motion of an *eccentric crank* (L). The crank is fastened rigidly through the crankpin to the spoke (K), and it remains at the same angle with the spoke as it rotates.



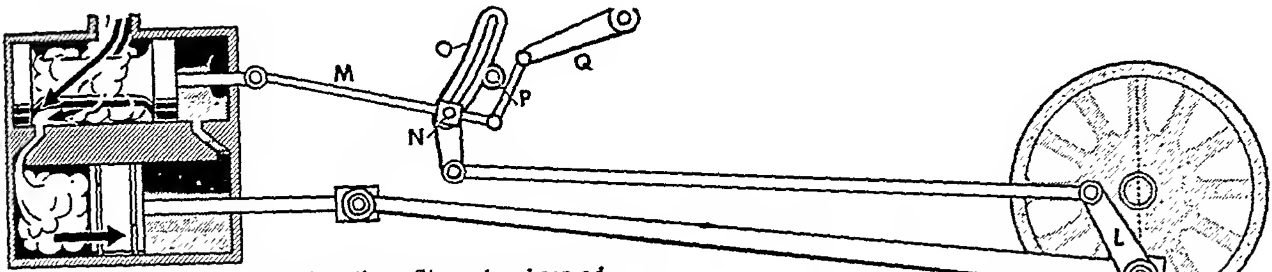
Valve shifting can hest he understood hy compariog this diagram with the one above. There the spoke (K) was turoiog to the right, and the eccentric crank had shifted the valve to the left. This admitted steam to the left side of the pistoo Here the piston, main rod, and the crankpin end of the craok are at the extreme right. The crank is drawiog the valve to the right, ready to admit steam to that end of the cylioder.



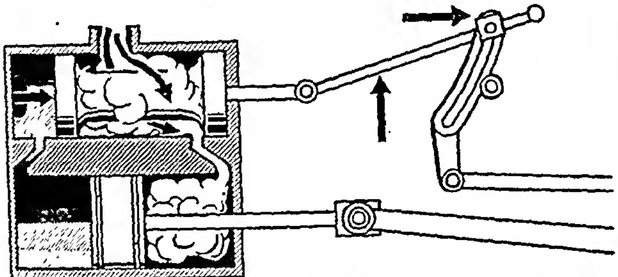
Here the crankpin end of the eccentric craok has beeo carried almost halfway to the left again. But the other eod is still about at the extreme right. Therefore the valve still admits steam to the right-hand end of the cylinder. Thus steam is supplied during a large part of the stroke, eveo though the wheel and the crank are turning conataotly.

HOW VALVE GEARING CAN RUN AN ENGINE IN REVERSE

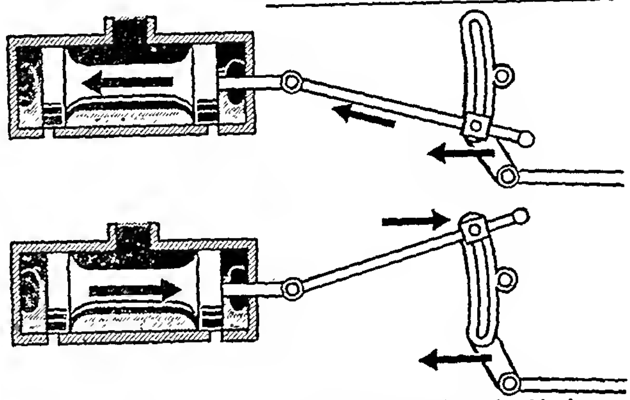
In the common Walschaert type of gearing, the valve stem is moved by a *radius rod* (M) attached to a sliding block (N) in a *reverse link* (O). The link is rocked on pivot (P) by a rod from the eccentric crank (L), and this rocking moves valve stem in and out. The rod and block can be moved up or down on the link by linkage (Q) to drive the engine forward or backward.



Here the gear is set for forward motion. Steam has been admitted at the left, and it has driven the piston halfway to the right. Later the admission of steam will be changed, as shown on preceding pages; and the alternating admissions will keep the wheel turning forward. The rod and the block are *down*.



Here the engine has been stopped after running forward. To start it running backward (in reverse) steam must be admitted to the right side of the piston. This is done by moving the radius rod and block up with the linkage (Q). But this motion forces the block to the right, and draws the valve stem and valve with the block. Now steam will be admitted at the right, when the engine is started again. This will draw the bottom of the wheel to the left and start the engine running in reverse. The reversing action is completed by reversing the later motions of the valve-shifting mechanism, as shown at the right.



Here is how valve motion is reversed. When the block was *down*, the valve moved *with* the eccentric rod. When the block is *up*, the valve and rod move in *opposite* directions. This reverses the admission of steam and runs the locomotive backward.

to force water in against back pressure from the steam. Finally, every boiler needs a *water gauge*, to warn when water falls below a safe level, and a *safety valve*. This usually has a spring which holds a valve closed tightly against normal steam pressure. If pressure rises unduly, it forces the valve open, releasing steam and relieving the excess pressure.

Modern boilers and engines use steam pressures of hundreds, or even thousands, of pounds to the square inch. Railroad locomotives and low-speed ship engines commonly use pressures from 250 pounds upward. Large turbines, such as those in electric-power generating stations, use pressures of from 1,400 to 2,000 pounds or more.

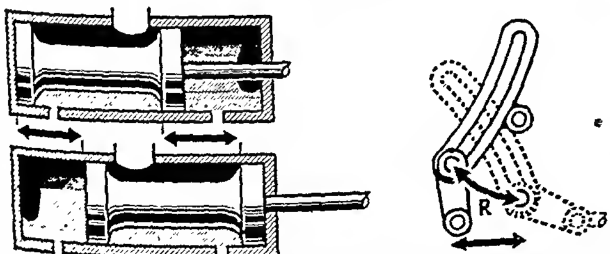
Reciprocating Engines and Turbines

The steam turbine is far more efficient than the reciprocating engine, and it is preferred for most services today. Because of its importance in modern use, it is described in a separate article (*see* Turbine). The illustrations in this article show how steam is used in the most commonly seen type of reciprocating engine, the railroad locomotive.

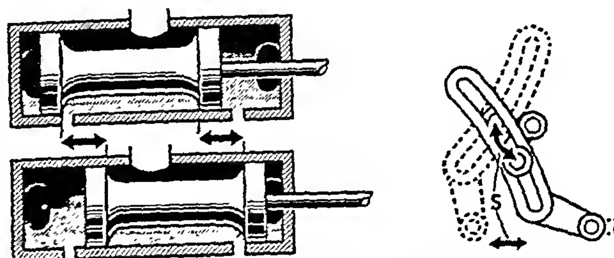
Turbines have many advantages over reciprocating engines. One is that they operate continuously

HOW VALVE GEARING CAN SAVE STEAM WITH "CUT OFF"

If steam is admitted to each side of the cylinder throughout each stroke, the engine develops maximum power. But usually this is needed only for starting and pulling up heavy grades. Whenever reduced power is sufficient the reversing link and attached parts can be set to admit steam for only part of each stroke. After the supply for each stroke is cut off, the steam already admitted to the cylinder expands to complete the stroke.

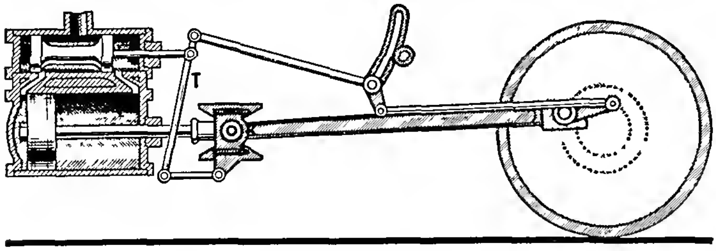


Here the block and radius rod are at the bottom of the link and move as the link rocks over space (R). The valve moves the same distance, well past each port, and admits steam for full strokes.



Here the block has been pulled up part-way on the link and moves over a shortened distance (S). The valve works closer to each port and cuts off admission of steam early in each stroke.

FUNCTION OF THE LAP-AND-LEAD LEVER



For quick pickup, an engine needs "lead"—that is, valve shifting a little ahead of piston movement. The lap-and-lead lever (T) does this. The diagram shows the action when the wheel is almost "dead center forward," and the piston approaches change of movement at the left. The eccentric crank is not quite ready to shift the valve. But the lever, driven by the crosshead, is almost completely to the left and has started the shift, giving "lead."

in one direction, instead of having to check and reverse their motion. They deliver directly the rotary motion which is wanted for most services. Because of greater efficiency, they are more compact than reciprocating engines delivering the same amount of power, and they need less space.

One disadvantage of turbines is that they must operate at high speed. This must be reduced by separate devices for low speed or for a range of speeds from low to high. Reducing can be done by gearing or by using the turbine to generate electricity and using the electricity in motors. These devices must also be used (or a separate turbine must be provided) if reverse motion is needed.

Early History of the Steam Engine

The first attempt to make practical use of steam seems to have been made by Hero of Alexandria in ancient times. His devices, however, were merely toys. (For a picture of one, *see* Jet Propulsion.) The first serious efforts to harness steam power were made in Britain in the 17th and 18th centuries when it became necessary to pump flood waters from deep coal mines.

In 1698 Thomas Savery made a practical steam pump by using steam to create a vacuum in a closed vessel and letting the vacuum "suck up" water. Denis Papin devised several modifications (including a safety valve and a piston to separate the steam and the water in the vessel).

In 1715 Thomas Newcomen used steam to raise a piston in a vertical cylinder. Then the steam was condensed, producing a vacuum; and pressure from the outside air forced the piston down. The piston was connected to work a pump. (For a diagram, *see* Watt.) According to tradition, an ingenious boy valve tender, Humphrey Potter, rigged cords to shift the valves as the piston moved and thus invented the first valve gear.

All these devices wasted steam because condensation in the working vessel cooled it, and considerable steam was used in reheating before the devices would make another stroke. And the time spent in reheating made the engine too slow for anything but a pump. Late in the 18th century, James Watt of Glasgow overcame these defects by using steam on each side of the piston and condensing exhaust steam in a separate vessel. The details of his invention are given in a separate article (*see* Watt). In effect, however, he created the first engine which would give a steady flow of power at a reasonable cost. This achievement brought into being the Machine Age.

Developments and Improvements

In 1807 Robert Fulton used one of Watt's engines successfully to drive a steamboat (*see* Fulton). But the engines were too heavy and slow for land transportation. In 1829 George and Robert Stephenson overcame this handicap in their locomotive *Rocket*. They used high-pressure steam and turned the exhaust up the smokestack (as others had) to create draft and keep the fire hot enough to maintain the needed pressure. They also built a fire-tube boiler to give the necessary heating surface (*see* Locomotive; Stephenson).

In 1845 John McNaught produced a successful *compound* engine. It used part of the force from high-pressure steam in a high-pressure cylinder, and the rest in a low-pressure cylinder. In 1874 A. C. Kirk added a third cylinder, giving *triple expansion*. In 1862 Randolph Elder used Bessemer steel to make a *Scotch* (*marine*) fire-tube boiler. These changes made steamships more economical to run than sailing vessels. The first water-tube boiler came in 1894. A few years later Dr. Wilhelm Schmidt of Germany developed *superheat*.

Development of the turbine was slow because high-quality steel and fine workmanship were not available until nearly 1900. In 1897 Sir Charles Parsons introduced a successful design in his steamship *Turbinia*. From then on, use of turbines grew rapidly.

STEEL. The word "steel" refers to metal refined from iron and then alloyed with various other chemical elements. Generally speaking, there are two grades of steel: *plain steels* and *alloy steels*. (*See also* Iron and Steel; Alloys.)

STEPHEN, KING OF ENGLAND (1097?–1154). The period of worst misgovernment in English history was the 19-year reign of Stephen, grandson of William the Conqueror. A prolonged contest for the throne resulted in virtual anarchy.

Stephen's predecessor, Henry I, made the barons accept as his successor his daughter Matilda, widow of the German emperor Henry V. After he died, however, the barons chose as king the easy-going Stephen of Blois, son of Henry's sister Adele. Matilda, however, fought for her right. Her husband, Geoffrey of Anjou, made good her claim to Normandy. After he died, their son Henry carried on the contest. Finally in 1153 Stephen, weary of the fight and saddened by the death of his son Eustace, accepted the treaty of Wallingford, which provided that Henry was to succeed. Stephen died the next year.

Meanwhile the country had fallen into anarchy. Lawless (adulterine) castles sprang up everywhere, and the owners lived by plundering the land and its inhabitants. Beset as Stephen was with his struggle for the crown, he did nothing to suppress these wrongs. It took strong effort by his successor, Henry II, to restore order. (*See* Henry, Kings of England.)

STEPHENS, ALEXANDER HAMILTON (1812–1883). Second only to Jefferson Davis among the statesmen of the Confederate States of America was Alexander H. Stephens, the vice-president of the Confederacy. He was a native of Georgia and rose to leadership despite a long fight with ill health and poverty. Like Davis, he had gained his experience in the United States Congress, where he served from 1843 to 1859. He resigned then because he "saw that there was bound to be a smash-up on the road and resolved to jump off at the first station."

Like Davis, Stephens opposed secession, making a speech against it before the Georgia legislature in November 1860 and voting against it in the Milledgeville convention in January 1861. When he was overruled in the convention, however, he cast his lot with the South. The next month he was elected vice-president of the Confederacy.

During the war he frequently opposed the exercise of extensive war powers by President Davis, though he had been one of the first to declare that slavery, not states' rights, was the cause of the war.

At the close of the war Stephens headed the Confederate commission which met President Lincoln and Secretary Seward at Hampton Roads, in February 1865, to confer on the terms of peace. He was later imprisoned for six months in Fort Warren, Boston Harbor, but was released upon taking the oath of allegiance to the United States. His devotion to the rights of the Negro won for him election to the United States Senate in 1866, but his participation in the war barred him from taking his seat.

Then for several years Stephens devoted his energies to the writing of his book, 'A Constitutional View of the War between the States'. In it he set forth the Southern position on the doctrines of state sovereignty and secession. For a long time this book was generally regarded as the ablest presentation of the Southern point of view. In 1873 he was finally allowed to take a seat in the House of Representatives. There he served until 1882 when he resigned to become governor of Georgia. He had one of the finest characters and was one of the most independent thinkers produced by the Old South.

STEPHENSON, GEORGE (1781–1848). Few great inventors had as humble a beginning as Stephenson. His father, whose earnings never exceeded 12 shillings a week, was fireman of a colliery pumping engine in the wretched mining village of Wylam, near Newcastle, England. The home of his parents and their six children was one room in a cottage near the pit mouth —a cottage which also sheltered three other families. School was not to be thought of; bread was not always to be had in sufficient quantity. In this grimy village he spent his babyhood; childhood saw him below ground. At 14 he was promoted to be his father's assistant at a shilling a day. At 21 he himself was an engine man at two shillings, with his father under him as a fireman.

Eager to add to his knowledge of engines and steam, Stephenson at 18 entered a night school, learning at the age of 19 to write his own name. His evenings and week ends were always full of work and study, and his self-improvement brought him steady promotion. At 31 he was "engine-wright" (builder and erector of stationary engines) at Killingworth Colliery, or coal mine, and earning $500 a year—a good salary then—and he sent his son Robert, born 1803, to school. He invented a miner's safety lamp; but his great ambition was to build a practical steam locomotive for use in mines.

The locomotives produced by Trevithick, Hedley, and others had a serious defect. They could not develop full power because the driving wheels slipped on the uneven tracks of the day. Stephenson attached each wheel to the body of the locomotive by means of a cylinder-and-piston device. This was supplied with a cushion of steam from the boiler and kept the wheel pressed tight to the tracks at all times. His second engine, built with this device in 1815, was completely successful and made him famous. He became a consulting engineer for railroads.

On Sept. 27, 1825, one of his engines, called "Active" (later renamed "Locomotion"), opened passenger service on the Stockton and Darlington Railway. But it was slow; and later, when Stephenson was given charge of construction for the new Liverpool and Manchester Railway, he persuaded the directors to offer a prize of $2,500 for a locomotive with speed and power enough to give good passenger service.

For the trials, held at Rainhill in October 1829, Stephenson let his son Robert build a new type of locomotive with a multitubular boiler. This locomotive, named the "Rocket," won the prize, even though another was faster, because the "Rocket" was the only locomotive sturdy enough for continued running. (For a picture of the "Rocket," *see* Locomotive.)

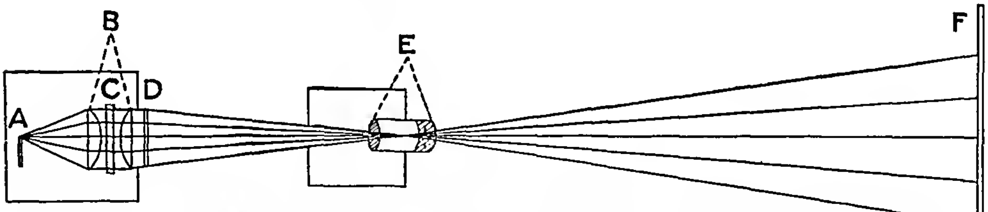
Thereafter Stephenson gradually turned over his business to Robert, who soon became a well-known locomotive builder and civil engineer. Among his engineering triumphs were the tubular iron bridge across Menai Strait and the Victoria Bridge at Montreal. George Stephenson died in 1848, Robert in 1859.

STEREOP'TICON. In the 17th century a certain learned Dane showed in Lyons, France, illuminated pictures projected on the wall by a marvelous lantern. Some people imagined that it must have drawn its strange power from supernatural sources. Yet that old "magic lantern" was a rather simple toy compared to the complex apparatus used today for throwing enlarged images on the screens at public lectures and for projecting moving pictures.

The principle, however, is the same in all "projection apparatus," as such instruments are called. The light passes through a set of large condensing lenses, which gather up the rays and distribute them equally over the transparent image on the slide. After passing through the slide, the beam of light, which is now carrying the image, concentrates upon the smaller objective lenses. These focus the image and project it upon the white screen where it becomes visible. (*See* Lens; Light.)

The slide consists of a piece of glass on which may be lettering, or images painted in transparent colors, or (more often) plain or colored photographs which are exactly like the ordinary photograph except that the gelatine film is supported on glass instead of on paper. In the case of moving pictures, a large number of small photographs, contained on a long roll of flexible film, pass in rapid succession behind the objective lenses (*see* Motion Pictures).

HOW PICTURES ARE THROWN ON SCREENS

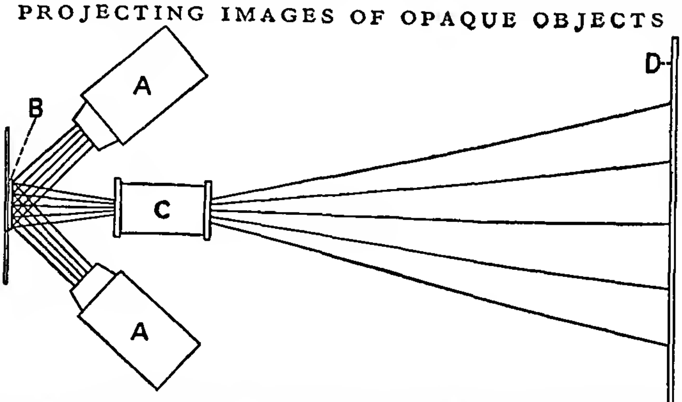


The vivid light from the arc (A) is caught by the condensing lenses (B), between which is a water cell (C) which cuts off the intense heat from the arc. These lenses focus the light through the transparent picture slide (D), then the brilliantly lighted image is caught by the double-objective lens (E) and focused on the screen (F). The whole device works like a giant camera, in which the lens "photographs" the image of the slide upon the back of the camera, the room or theater playing the part of the camera box.

To protect the slide or film from the intense heat generated by the light, a water cell is usually placed between the condensing lenses. The light, placed in a box known as the lamp house, must be brilliant and steady. In the early days operators used an acetylene gas flame, a Welsbach mantle, and even a double or triple flame kerosene burner. Limelight was an improvement. But the brightest of all was the electric arc. Another device is special nitrogen-filled tungsten lamps, of 400 to 1,000 watts. These can be run from the ordinary 110-volt electric circuits of the home.

The name "stereopticon" is sometimes applied to a double lantern with the two objectives arranged to focus on the same spot, so that one view may fade into another, or a snow or rain effect may be super-imposed on a clear landscape.

PROJECTING IMAGES OF OPAQUE OBJECTS



Here we see how pictures of objects which are not transparent can be thrown on the screen. The two arc-lamps (A) concentrate intense light upon the object (B), and the reflected light from the object is focused by the large objective lens (C) upon the screen (D).

There are several types of instruments for projecting on a screen images of non-transparent or opaque objects. In one of the simplest of these, the "balopticon," the opaque object is intensely illuminated by two lights, each similar to the stereopticon light. The light rays are then reflected back through lenses to the screen.

It is easier to understand the principles of projection apparatus if we compare them to photographic processes. In this case the darkened lecture hall takes the place of the camera. The objective lenses of the projector, just like the camera lenses, are focused upon the transparent slide or upon the brilliantly lighted opaque object, and project its image upon the screen, which corresponds to the photographic plate or film (*see* Photography).

Stereoscope. Of what use is it to us to have two eyes instead of one? Perhaps you think that both eyes see the same object in the same way, but such is not the case. The right eye sees more of the right side of an object, the left eye more of the left side, as you may observe by looking at an object with one eye closed, then the other. The brain puts these two images together and sees them as one (binocular vision). Thus we get our impressions of depth, solidity, or relief.

The ordinary camera has only one "eye" or lens—consequently its photographs appear flat. The principle of the stereoscopic picture is the same as that of the eyes, for it presents two images taken through two lenses. Two photographs of an object or scene are taken simultaneously by a "stereoscopic" camera, so arranged that one lens photographs it from an angle slightly to the right and the other from an angle to the left. These photographs (stereographs) are then mounted side by side on a card.

The stereoscope itself is an instrument with a similar pair of lenses for viewing such photographs. The two images are blended by the brain so that we see a single picture, in which every part stands out solid with lifelike effect.

The principle of the stereoscope (from the Greek words *stereos*, "solid," and *skopein*, "to see") is used in binocular ("double-eyed") field glasses and in opera glasses. There are also binocular microscopes and telescopes, and motion picture films based on the same principle (*see* Motion Pictures). Stereoscopes are modern inventions, the first instrument of the kind having been devised by Sir Charles Wheatstone (1802–1875), English physicist and inventor, in 1832. The open form of stereoscope, which is now commonly used, was devised by Oliver Wendell Holmes, the American essayist and poet, and perfected according to his plans.

STEREOTYPING. Large daily papers are printed with rotary presses which use curved plates. These plates must be made very rapidly. To produce them from flat forms containing type and halftones, the process called stereotyping is used. A large sheet of heatproof papier-mâché, rubber, or plastic is pressed down hard on the form to make a mold of its surface. This is called a matrix or mat. It goes into a caster which curves the mat to a half cylinder. Molten type metal pours in between the face of the mat and the core of the caster, producing a thin, curved plate called a stereotype. Each press cylinder carries two stereotypes around its circumference, representing two pages of the paper. Sets of two can be spaced along the entire length of the cylinder.

Many stereotypes can be made from the same mat or portion of a mat, and they can be made flat for flat-bed presses as well as curved. Ready-made news "fillers" and syndicate features are supplied in this way to country newspapers. Excellent printing results are obtained with modern stereotypes, and because they are cheaper than electrotypes they are gaining ground in the book and magazine field. (*See also* Electrotyping; Newspapers; Printing.)

STEUBEN, FREDERIC WILLIAM AUGUSTUS (1730–1794). Baron von Steuben was a brave German soldier who came to America during the Revolutionary War to aid the colonial forces. Steuben was born Sept. 17, 1730, in Magdeburg, Germany. He began his military career as an officer when he was only 17 years old, and he had served in two great European wars before he came to America. As he had been an officer under Frederick the Great of Prussia, the greatest general of the time, he was of inestimable value to the colonists in training their troops, even though he spoke no English.

During the dark days of Valley Forge he turned Washington's body of raw recruits into an efficient well-trained army. He was next sent to the South to "collect, organize, and discipline" recruits, a task he carried out with rare efficiency.

After the war he spent the rest of his life in America. New York, Virginia, Pennsylvania, and New Jersey gave him grants of land for his services during the war, and Congress passed a vote of thanks, gave him a gold-hilted sword, and later granted him a pension of $2,500 a year. He died Nov. 28, 1794, at his estate in what is now Utica, N.Y.

STOUT-HEARTED "R. L. S."—*Teller of Tales*

STEVENSON, ROBERT LOUIS (1850–1894). The history of English literature records no braver story than the life and work of the happy and gifted storyteller, poet, and essayist Robert Louis Stevenson. Born Nov. 13, 1850, in Edinburgh, Scotland, he spent much of his childhood in bed, always ill with lung trouble. He died at the early age of 44. For 20 years, while waging one long fight with death, he produced an enormous quantity of work of enduring quality. He did not permit constant pain and overpowering weakness to affect his gaiety or his imaginative writing.

ROBERT LOUIS STEVENSON

Stevenson's stories, full of mystery and adventure, are enduring favorites of readers of all ages.

In his autobiographical poems 'A Child's Garden of Verses' Stevenson shows how, shut away from ordinary childish pleasures, he created a wonderful world of romance out of the simplest things. His bed was "the pleasant land of counterpane," not a weariness. His mother read to him the stories which he loved to hear, and his devoted Scottish nurse Alison Cunningham kept him alive by her constant care.

No regular schoolwork was possible in his childhood. He lived much of the time in a beautiful country home or took journeys with his father, a civil engineer, inspecting lighthouses and harbors about the wild coast. His mind became filled with images of mountain, moor, and seagirt isles.

When he grew older, he was able to take courses in Edinburgh University and to study engineering and law. With his frail health, however, he could not carry on his father's business of engineering or practice law. Writing was the only work left open to him.

Becoming a Writer

He spent several years wandering through France, Germany, and Scotland for his health. Records of these journeys were given to the reading public in 'An Inland Voyage' in 1878 and 'Travels with a Donkey' in 1879. Readers were charmed by Stevenson's delightful conversational manner and by the graceful flow of his style. They did not realize how hard a schooling he had given himself in the art of writing. In 1887 he wrote in a letter, "I imagine nobody had ever such pains to learn a trade as I had, but I slogged at it day in and day out; and I frankly believe (thanks to my dire industry) I have done more with smaller gifts than almost any man of letters in the world." Only art, not work, shows in his writing.

BILLY BONES GETS THE "BLACK SPOT"

This scene in the Admiral Benbow Tavern marks the start of 'Treasure Island', Stevenson's best-known story. Blind Pew has put the warning symbol into Billy Bones's hand and makes off while young Hawkins looks on, amazed at the old seaman's terror.

All his life he labored for perfection in his writing. With the publication of his first long tale, 'Treasure Island', in 1883, Stevenson became widely popular. He wrote many essays, poems, and short stories, and then in 1886 another absorbing story of adventure, 'Kidnapped'. Stevenson did not concern himself with the problems of life and society, the mysteries of thought and conduct into which George Eliot and Thomas Hardy and other realists of the 19th century delved so deeply. He returned to the pure romanticism of Scott—the love of a story for its own sake, the delight in adventure, the spirit of eternal youth.

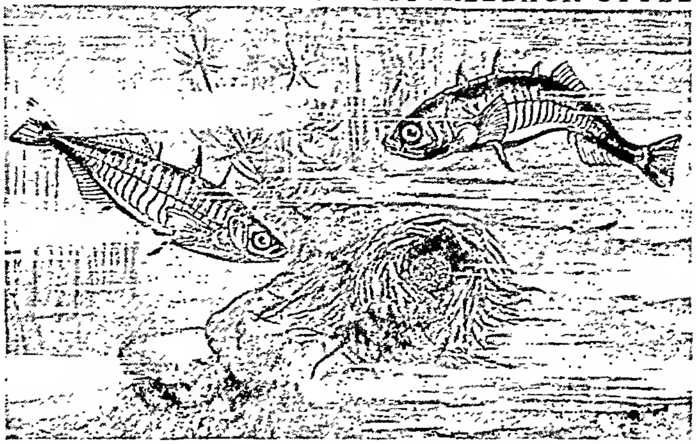
The great romance of Stevenson's life began in France in 1876, when he met Mrs. Fanny de Grift Osbourne. Stevenson knew immediately that she was the one woman for him. But there were many difficulties. She returned to her home in San Francisco and Stevenson, hearing that she was ill, decided to follow her. He crossed the Atlantic in the steerage and the continent in an immigrant train. The experience gave him material for several books but, together with the hard times he suffered in San Francisco, nearly killed him. He developed tuberculosis and would have died had it not been for Mrs. Osbourne, who nursed him back to health. In 1880 they were married, and Stevenson returned with his wife and stepchildren to Scotland, where they were welcomed into his father's home. The stepson, Lloyd Osbourne, collaborated with Stevenson in some of his stories and later won considerable distinction as a writer on his own account.

Stevenson could not stand the severe climate of Scotland and so for years he wandered from place to place in search of a climate where he might live and work. After an extended South Sea Island cruise he settled at last with his family in one of the Samoan Islands (Upolu) in the South Pacific, where he bought a large estate. Here he enjoyed fairly good health. He took a great interest in Samoan affairs and was beloved by the natives, who called him "Tusitala" (teller of tales). The end of his brave struggle came quite suddenly on December 3, 1894. While talking gaily on the veranda of his house at Vailima he had a stroke of apoplexy and died within a few hours. The natives carried his body to Mount Vaea, cutting a path to the summit with their knives and axes. There they buried him and there he lies today in a windswept solitude overlooking the Pacific, with one

of his brave verses for an epitaph:

Under the wide and starry sky,
Dig the grave and let me lie.
Glad did I live, and gladly die,
And I laid me down with a will.
This be the verse you grave for me:
"Here he lies where he longed to be.
Home is the sailor, home from the sea,
And the hunter home from the hill."

SUBMARINE WARFARE—STICKLEBACK STYLE



Small but fierce, the male stickleback will fight to the finish any other fish that threatens the nest where the female stickleback has laid her eggs. The male guards the eggs until the young are hatched. The species shown here is the threespine stickleback.

Stevenson's best-known works are: 'An Inland Voyage' (1878); 'Travels with a Donkey' (1879); 'Virginibus Puerisque' (1881); 'Familiar Studies of Men and Books' (1882); 'New Arabian Nights' (1882); 'The Silverado Squatters' (1883); 'A Child's Garden of Verses' (1885); 'Prince Otto' (1885); 'The Strange Case of Dr. Jekyll and Mr. Hyde' (1886); 'Kidnapped' (1886); 'The Merry Men and Other Tales' including 'Markheim' and 'Will o' the Mill' (1887); 'Underwoods' (1887); 'Memories and Portraits' (1887); 'The Wrong Box' (1888); 'The Master of Ballantrae' (1889); 'The Wrecker' (1892); 'The Ebb Tide' (1893); 'Catriona' (1893); 'David Balfour' (1893); 'Weir of Hermiston' (unfinished).

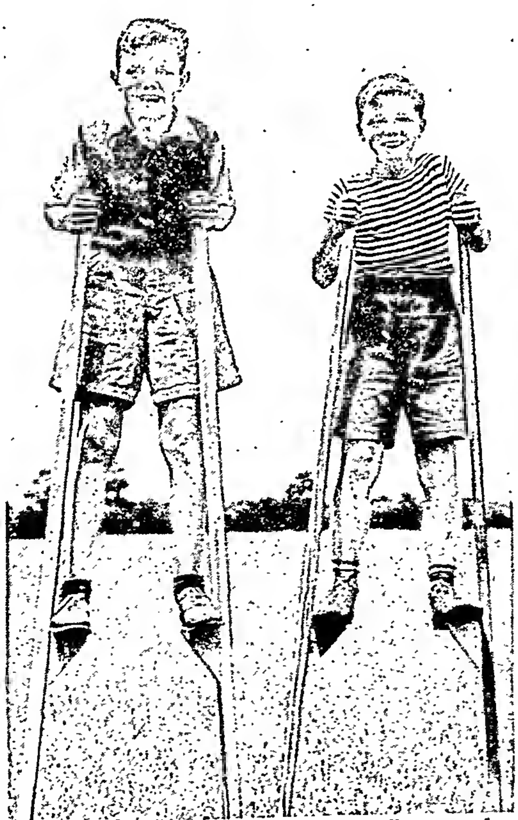
STICKLEBACK. Ounce for ounce, this small fish is as full of fight as any fish in the salt or fresh water where it lives. The male is especially full of fight during the mating season. It will duel to the death any other fish that invades the place where the stickleback plans to build a nest. Sharp, thornlike spines on its back are the stickleback's weapons and give the fish its name.

The male builds a tunnel-shaped nest, binding bits of water weeds and roots together with a tough, white thread which it produces from an internal gland as a spider does a web. After several female sticklebacks fill the nest with eggs, the male enters it and stands guard. Although the fresh-water stickleback is usually no more than three or four inches long, it will not hesitate to attack a marauding fish several times its own size. Ocean sticklebacks sometimes grow to be seven inches long.

The stickleback is itself a marauder and does great damage to eggs and the young of other larger fish. Its appetite is enormous. A small stickleback in an aquarium has been known to devour 75 newly hatched minnows, each about one quarter of an inch long, in five hours' time. If two sticklebacks are placed in an aquarium, they will fight until one or the other becomes master. For these reasons it is not wise to include sticklebacks among the fish in an aquarium.

Sticklebacks are found throughout the north temperate zone, along seacoasts as well as in freshwater streams. They live for only about three years. They are generally identified by the number of spines on their backs. Each species, however, varies greatly. The brook stickleback (*Eucalia inconstans*) has five spines. It is abundant in small streams in Canada and in the United States from New York to Kansas. The brook stickleback has an English cousin which is sometimes called the "tittlebat." This species was made famous by Charles Dickens when Mr. Pickwick talks about "the tittlebat" in the series of sketches 'Pickwick Papers'.

HAVING FUN ON STILTS

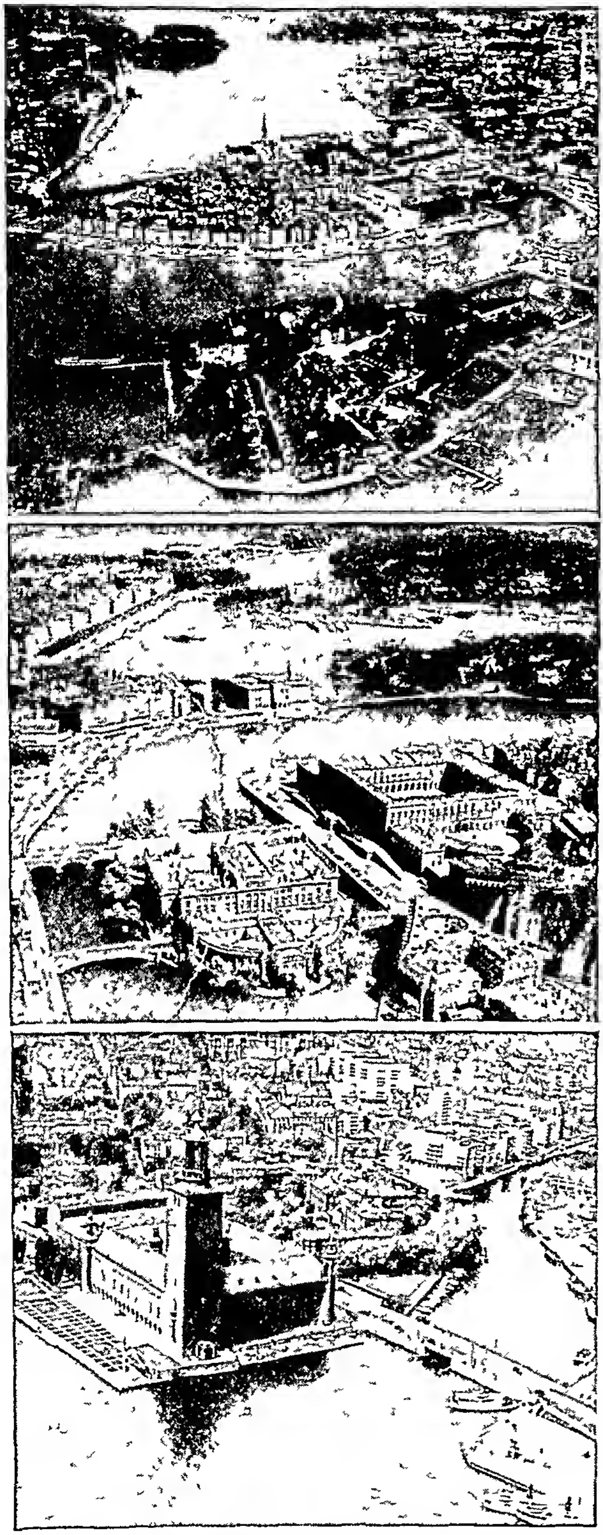


These American boys probably think stilts were designed solely for amusement. But they were originally made for crossing streams and marshes.

The fourspine stickleback (*Apeltes quadracus*) is a salt water species. In addition to spines on the back it has two swordlike spines near its front fins. The nine-spine stickleback (*Pungitius pungitius*) is found in both North America and northern Europe. During the mating season the male of this species turns almost jet black. The sea stickleback (*Spinachia vulgaris*) is armed with 15 spines.

STILTS. Sometimes a child gets tired of being small. When this happens he can increase his stature to giant size and walk with big strides on a homemade pair of stilts. He can start with a pair of common clothes poles, if they are of good tough wood. All he has to do is to fasten on them securely some wooden blocks for footrests. Then he mounts his stilts from a porch or a

IN "THE VENICE OF THE NORTH"



In the upper picture we see two of the islands across the mouth of Lake Malaren. The lower wooded island is the site of a navy yard; the upper is Staden, the very heart of Stockholm. In the middle picture we see a part of Staden, including the great rectangle of the Royal Palace, with the House of Parliament to the left. The bottom picture shows the famous Town Hall. These air views show how the waterways of Stockholm resemble those of Venice.

chair, grasping the tops of the poles firmly. He finds walking easier than he had expected. With a little practise he becomes expert and is able to stalk along at good speed or stand stock-still, towering over his pigmy playmates. Ready-made stilts of smooth hardwood can be bought in sporting-goods houses. These are adjustable to various heights.

Stilts were originally designed for fording rivers and crossing marshes. They were used in Europe by soldiers as well as civilians. Footrests were often five or six feet above the ground. The stilts were fastened to the legs below the knees. The stilt-walker carried a long pole which he used as a cane to balance himself or as a prop when he wanted to rest, placing it behind him so as to form a tripod. Expert stilt-walkers could travel as fast as a horse can trot.

Before the marshes of the Landes in southwest France were drained, stilts were considered indispensable by the shepherds there. They were also much used by the townspeople of Namur, Belgium, when the rivers were in flood. About 1600 the governor of Namur promised Archduke Albert a company of soldiers that should neither walk nor ride. The soldiers presented themselves on stilts. The archduke was so pleased with his amphibious troop that he exempted Namur from part of its taxes.

STOCKHOLM, SWEDEN. The capital of Sweden, Stockholm, is called the "Venice of the North" for a good reason. The heart of the city is built on thirteen small islands in the Norrstrom (North River), a stream which joins Lake Malaren to the Baltic Sea. Channels of the river twist around the islands, turning some of the city's main streets into waterways. Steamers, ferries, motorboats and billowing sailboats plow the water from quay to quay in the city. Boats serve as the city's taxicabs, busses, and trucks for door-to-door delivery by water. Arched stone bridges span the waterways at intervals, joining each part of the city.

Around these islands, the city spreads out over rocky cliffs on either side of the river. On the north bank of the river are Norrmalm, the modern business and theater district, and Östermalm, a residential section. The buildings of Sodermalm, a manufacturing center, cling to the steep cliffs of the south bank. The western portion of the island section is Kungsholmen, an industrial area.

"City between the Bridges"

Remnants of medieval days survive on three small islands, Staden, Riddarholmen, and Helgeandsholmen. They are closely connected, and they form the "city between the bridges." Here Stockholm was founded in the 13th century by Birger Jarl. The island was provided with a stone fortress to protect the inland villages from fierce pirates that plundered the Baltic Sea coast. During the Middle Ages, the fortress became a thriving port and trading center. Today it is the commercial center of the city.

Staden Island has old gabled houses and narrow streets not found in other sections of the city. On the north corner of the island facing the water is

the Royal Palace, built almost 200 years ago. Cobblestone streets wind up from the palace to the old Stortorg (Great Market). Here occurred the famous "Stockholm Blood Bath" of 1520. Eighty-two Swedish noblemen were executed in the market square by the Danish King Christian II.

Close to Staden is Riddarholmen ("nobles' island"). Here stands Riddarholmen Church, Sweden's temple of fame, where most Swedish rulers are buried. The building has an openwork iron spire 295 feet high.

North of Staden is the tiny Island of the Holy Spirit, where the House of Parliament stands. The two are connected by the Norrbro (North Bridge). The bridge continues northward and ends in the Gustavus Adolphus Torg (square), in the Norrmalm section on the mainland. Here stands an equestrian statue of Sweden's greatest ruler, Gustavus Adolphus. Facing this square are the opera house, the Royal Theater, and the palace of the crown prince.

From Logs to Granite Buildings

Once Stockholm was a city of log houses, built from the great forests around the city. From this fact, Stockholm ("the isle of the log") derived its name. After six destructive fires, however, the people built their capital of granite.

Today Stockholm is a city of broad streets and uniformly low buildings made of white granite, brick, or stone. This gives the city a clean, uncrowded appearance. Business houses, homes, and coöperative apartments are built in a plain, unadorned style. This is Swedish modern architecture, developed in the 20th century. Sweden's builders rejected traditional styles and turned to simple, modern building designs. The most famous building of the modern style is the rectangular Town Hall on Kungsholmen, an island overlooking Lake Mälaren. The hall is built of wine-colored brick.

Summer and Winter in the Capital

Many islands east of Staden are devoted to parks of trees and flower gardens, which bloom vividly in summer. Plant life flourishes in the short, growing season from May to mid-September because of the generous rainfall.

Citizens enjoy the long, cool summer evenings in the parks. Some days in June are over 20 hours long, and in July the mean temperature is 62° F. Midsummer's Day (June 24) is celebrated in the parks by dancing around *Maj* (green leaf) poles. Many of Sweden's best resorts are located around Stockholm and attract crowds for swimming and yachting.

Winter brings cold weather that freezes the waterways and blankets the capital with snow. Stockholm is less than 500 miles from the Arctic Circle, but warm winds from the Gulf Stream temper the weather. The mean low temperature of 26° is in February. Great icebreakers are used to keep the harbor open, and parks are provided with ice-skating rinks and steep runs for skiing and tobogganing.

Center of Culture, Industry, and Commerce

Many learned societies, such as the world-famous Nobel Institute, have their headquarters in Stockholm. Royal academies of the city give instruction in music, painting, sculpture, architecture, agriculture, and science. The Caroline Institute (a medical foundation) and a municipal university are located here.

The city's industry ranks first in the country. Stockholm manufactures iron and steel products, pottery, leather, machinery, porcelain, and textiles. Shipbuilding is an important industry, and Stockholm has a good harbor which handles 11,000,000 tons of commerce yearly. It is first in Sweden in volume of imports, and second in exports only to Göteborg. Population (1950 census, preliminary), 745,936.

STOCKINGS. Short stockings, or socks, and long stockings which cover the feet and legs made a late appearance in man's wardrobe. Not until the 16th century did women learn to knit so that they could make a stretchy seamless stocking out of a single thread.

The Greeks and Romans thrust their bare feet into sandals and left their legs uncovered. "Sock" to the Anglo-Saxon meant a low shoe. "Hose" were leggings without feet. The hose were cut from coarse wool or leather and seamed like the separate legs of trousers. Hose fit the legs loosely. To keep them tight to the leg, a strip of cloth or leather called a "cross garter" was wound around them.

In the 13th century, the fit of hose was improved. Feet with leather soles were attached. For a while people stopped wearing shoes altogether. In the next century, people kept the feet on their hose and wore shoes over them. The separate legs of the hose were joined together and reached to the waist. This formed a pair of well-fitting tights. Men of the nobility wore tights of rich silk or velvet in gaudy colors. Their wives wore linen hose under their long skirts.

Knitting Made Comfortable Stockings

The heavy seams in the feet of the hose were uncomfortable. The art of knitting, introduced in the 15th century (probably from Spain or Italy), solved this problem. Knitted socks had no seams and were very comfortable. By the middle of the 16th century European women were knitting woolen caps and hose. Queen Elizabeth I of England wore handknit stockings of black silk. A knitting frame was invented at this time, and stocking manufacture became an important industry (*see* Knitting Machines).

In the 20th century there was a change in the material used for hose. Cotton was used in the United States for most manufactured hose until the first World War. After the war, skirts became shorter, and natural silk and cheaper rayon fibers became popular material for women's stockings. Then nylon, a synthetic fiber with high elasticity, took the place of silk for higher priced stockings. Socks are made of cotton, rayon, nylon, and mixtures of the three. Wool socks are popular for sports wear.

"Full-fashioned" hose are stockings that fit tightly to the leg. Originally these were knit on a flat frame and seamed, because it was impossible to shape well-fitting hose without a seam. Today, however, seamless nylon hose can be shaped during manufacture. They will remain "full fashioned" through their lifetime.

INVESTING MONEY *in* STOCKS *and* BONDS

STOCKS AND BONDS. Everyone who has savings has money to invest. The most common form of investment is life insurance although it is not always thought of as savings. Some people put their savings in banks, some in real estate, and some in stocks and bonds.

World War I promoted the great American interest in *securities*, as stocks and bonds are called. The United States government sold Liberty Bonds to raise money for the war effort. People who had never before purchased a bond bought Liberty Bonds for patriotic reasons. For many of these purchasers it was a simple step from this investment to putting savings in the stocks or bonds of America's great corporations, such as American Telephone and Telegraph, Standard Oil, and United States Steel.

Bonds differ from stocks in one basic respect. A bond is an evidence of debt. A bondholder is a creditor who has lent money. A stock is an evidence of ownership. A stockholder is an owner who has a share in the business. Stocks and bonds are issued by corporations which want to raise money, or *capital*, to carry on a business (*see also* Corporations). Bonds may also be issued by national, state, and local governments, as well as by agencies of governments, such as school boards and water districts.

Buying Bonds as Investments

Bonds are usually issued in $500 and $1,000 units. The bondholder receives a certificate stating the amount of money loaned, the interest rate paid for use of the money, and the date the borrower promises to repay the bondholder, or lender. Repayment cancels the bond, or debt. (*See also* Percentage and Interest.)

Interest is customarily paid every six months. Some bonds have attached coupons representing each semiannual interest payment. On the date specified the coupon can be cashed just like a check.

Most bonds are issued in bearer form—that is, possession is proof of ownership. Thus they can be passed from one person to another. Some bonds, however, can be registered. Then the owner's name is on the bond. Such a bond has to be sent to the issuer for transfer of title when it is sold. Most registered bonds do not have coupons attached. Interest is paid by check.

Bonds issued by the United States government have the highest credit rating. They are not secured by a pledge of assets or a mortgage. They are, however, protected by the full taxing power of the government. Similarly, most bonds issued by state and local governments are not secured by specific assets. In some cases, states and municipalities issue bonds for which specific income is reserved. For example, the tolls collected on a turnpike may be pledged to pay the interest and principal on turnpike bonds.

During World War II the United States government began issuing savings bonds for as little as $18.75 for each so-called "E" bond. The purchaser of an E bond does not receive interest until he cashes in his bond, which he can do at any time after 60 days. If he holds the bond to maturity—about ten years—he receives $18.75 in payment of his original principal plus $6.25 in interest. This amounts to an interest rate of about 3 per cent. This rate is payable for another ten years if the bond is not cashed at maturity.

When railroads, public utilities, and industrial corporations issue bonds, the bonds are often secured by a mortgage on specific properties. If the company fails to pay interest or principal when due, the bondholder may start legal proceedings to take possession. The bondholder does not, however, have a voice in the affairs of the corporation. Bonds which are not secured by a pledge of assets but merely by the general credit of the corporation are called *debentures*. Most bonds can be redeemed—that is, called before they come due. To call bonds, the issuer usually pays a premium over the price at which the bonds are selling. Companies which have been in financial difficulty sometimes issue *income bonds*. On such bonds the interest is payable only when current earnings make it possible to do so.

Common and Preferred Stocks

Stocks are of two types—common and preferred. The preferred stockholder is an owner in the corporation, but with limited rights. He is entitled to dividends before the common stockholder can share in the profits of the company. If the company is liquidated, the preferred stock is paid off before the common.

Dividends on most preferred stocks are fixed and cumulative. They do not increase if the company prospers. They may, however, be reduced or suspended if earnings are poor. If they are reduced or suspended, they cumulate and are paid when earnings improve. Most corporation charters provide that if dividends on preferred stocks are suspended for a specified period, the preferred shareholders get voting rights in the corporation. Most preferred stocks, like bonds, can be called.

Sometimes preferred stocks or bonds are convertible into common stocks. The right to convert is an inducement to investors who want a fairly certain income but who also want the chance to share in the profits if the company prospers.

Common stockholders are not entitled to any set return on the use of their money. They may, however, receive common dividends declared by company directors when profits exceed interest charges on bonds and payments of preferred dividends. Each common stockholder is entitled to his proportionate share of these dividends. If the dividend is $1 a share and the stockholder owns 100 shares, he receives $100.

Dividends are sometimes paid in stock as well as in cash. A 2 per cent stock dividend would mean two extra shares would be given to each holder of 100 shares. Sometimes companies will split their stocks by giving two, three, or four shares for one. In a three-for-one split, the shareholder gets three shares for each one held. Although he has more shares now,

TRADING ON THE NEW YORK STOCK EXCHANGE

When an order to buy or sell shares of stock is telephoned to the floor of the Stock Exchange, a floor broker goes to the post which deals in that particular issue. He completes his "trade" with another broker representing some other customer.

his proportionate interest in the company is unchanged. Corporations split stock to attract small investors. People seem more inclined to buy ten shares of a stock selling for $30 than three shares of a stock selling for $100.

Some companies issue rights to shareholders to subscribe to stock or other securities at favorable prices—often below the market price. Such rights are valuable and can be sold. American Telephone and Telegraph often offers rights to its shareholders to subscribe to convertible debentures.

Voting Rights and Par Value

Most common stocks provide their owners with voting rights to choose the directors of the company. The directors, in turn, choose the officers, called the *management*. Each share of common stock has one vote. Thus a holder of 100 shares has 100 votes. Only rarely do corporations issue nonvoting common stocks. Such a device enables the management to hold on to the voting shares and sell the nonvoting shares to the public. In this way ownership of only a small proportion of the stock provides control of the company.

The common shareholder is entitled to receive company earnings reports and he may attend annual meetings where he can ask questions about company affairs. In practice, however, few stockholders attend these meetings. The holder of just a few shares is unwilling to travel long distances to attend meetings. Furthermore, no meeting room would be large enough to seat all the stockholders of a large company. One tenth of the shareholders of American Telephone and Telegraph would overflow the largest football stadium in the United States. Stockholders who do not go to meetings often vote by *proxy*. This means that they assign their right to vote in writing to persons usually appointed by the management.

Most stockholders' meetings are routine but occasionally a fight for control of the company will break out. This happens when a group opposed to the present management tries to elect its own board of directors, who will then replace the officers. To have control requires 51 per cent of the votes. During a fight of this kind management and the opposition group campaign for votes—proxies—very much as candidates do in a political election. A famous proxy fight occurred in 1929 when John D. Rockefeller, Jr., ousted Robert W. Stewart from the presidency of the Standard Oil Company of Indiana. In a similar fight in 1954 Robert R. Young, chairman of the Alleghany Corporation, an investment company, sought and gained control of the New York Central Railroad, second largest in the nation. In earlier days struggles for control occurred in the marketplace rather than through appeals to stockholders for proxies.

Stocks are registered in the owners' names and dividends are paid by check. When a stock is sold, it must be endorsed on the back of the stock certificate by the seller.

Many stocks have a stated value on the certificate, such as $1, $5, $25, or $100. This is the face value,

or *par value*. Originally the par value was the amount of money, or capital, paid in by the shareholder. It represented the assets behind the stock. Today the par value does not have a direct relation to the assets of the company or to the market value of the shares. Therefore some companies issue stock without any stated value—"no par" stock. It may be sold at any price while par value stock cannot be sold initially for less than its stated value.

About 6,500,000 people hold shares in publicly owned corporations. The most widely held common stock is American Telephone and Telegraph. It has more than 1,250,000 shareholders. General Motors has more than 500,000 shareholders; and Standard Oil of New Jersey, more than 250,000.

The Small Investor and the Stock Exchanges

Since World War II a new type of security has gained acceptance among small investors. This is the *mutual fund*. A mutual fund sells its own stock to investors and then invests this capital in the securities of other companies, such as railroads. (*See* Trusts.)

Mutual funds redeem their shares on demand, the investor being entitled to his proportion of the fund's assets. If the stocks, bonds, and cash of the company amount to $10,000,000 and there are 1,000,000 shares outstanding, then the redemption value is $10.

To meet the needs of the small investor who would like to buy stock systematically, the New York Stock Exchange sponsors a periodic investment plan. In this plan, as little as $40 every three months can be invested in common stock through brokers.

People would hesitate to invest in securities if they could not cash their investments in times of need. That is what stock exchanges are for—to bring buyers and sellers of securities together. The first organized stock exchange was founded in Philadelphia in 1790. Today the New York Stock Exchange, founded two years later, is the largest in the nation. It accounts for about 85 per cent of the dollar value of all trading on stock exchanges in the United States. The next largest is the American Stock Exchange, formerly called the New York Curb Exchange. It does more than 5 per cent of the total trading. Other cities with exchanges include Boston, San Francisco, Chicago (Midwest), Philadelphia (Philadelphia-Baltimore), and Los Angeles.

Only members may trade in securities on the floor of a stock exchange. Membership, or *seats*, are limited. For selling or buying a security for a customer, members receive fees, called *brokerage*.

Buying and Selling Securities

To buy a security, a person visits, writes, or telephones a broker. The buyer gives the broker the name of the security he wants and the price he is willing to pay. He then establishes his credit or puts up money for a purchase. The broker notifies his representatives on the floor of the exchange.

If the security is selling above the specified price, the floor broker cannot complete the order until and if the price comes down. If the security is selling at the price specified, or lower, the floor broker buys it

READING THE LATEST MARKET QUOTATIONS

G. Keith Funston, president of the New York Stock Exchange, is looking at the tape coming out of a stock ticker. This ticker service gives the latest selling prices of stocks.

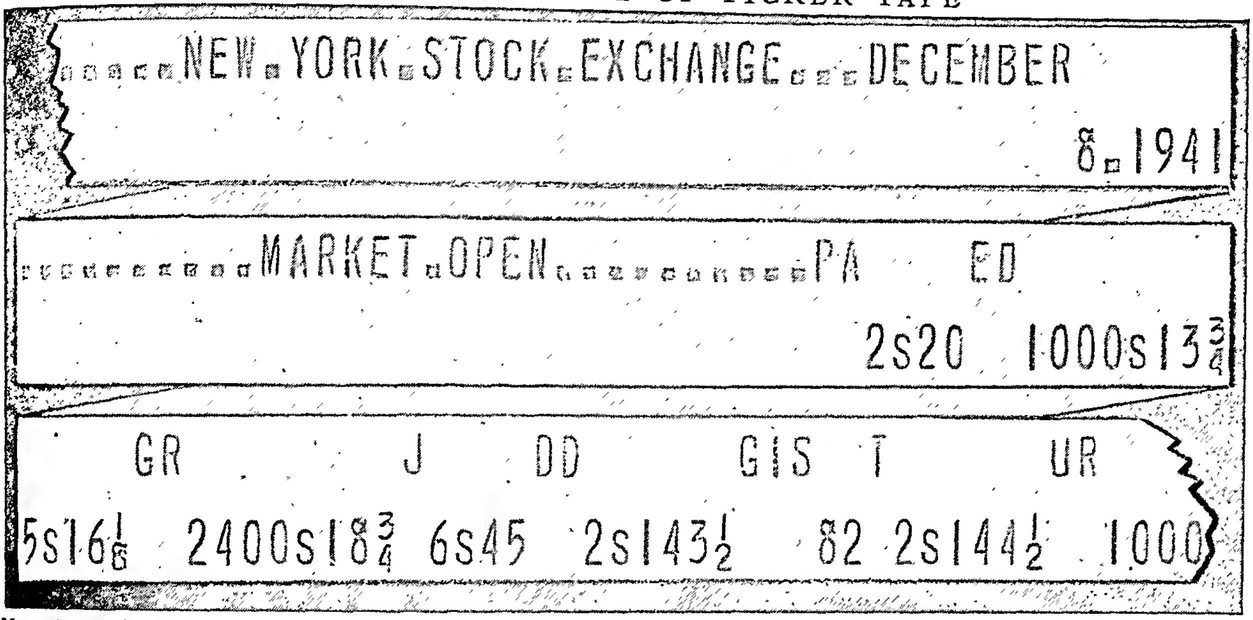
at the lowest possible price. To "buy at the market" means getting the stock immediately at the lowest price offered. The procedure in the sale of a security is the same.

The usual unit of trading on an exchange is 100 shares, a "round lot." Smaller lots—"odd lots"—can be bought at a fractionally higher price than round lots. In a sale of odd lots, the selling price is fractionally lower than round lots.

Securities not listed on exchanges—"unlisted securities"—may be traded *over-the-counter*. In the over-the-counter market, the securities dealer may act as a principal and buy stock from the investor or sell directly to him. Then his profit is in the price he charges. Some securities dealers act only as brokers, or middlemen, in dealing in unlisted securities. They then charge a commission for their services.

The market value of a stock depends on many things: the company's earnings, prospects, reputation of its management, and the state of business. Over the years stock prices have tended to fluctuate with business. During periods of good business companies will earn money and pay high dividends. In periods of poor business profits and dividends fall. The stocks of long successful companies—through good times and bad—generally command higher prices than the securities of unproven companies. For bonds, the buyer considers the security behind his loan. The price is higher if the bond is a mortgage on valuable property.

AN HISTORIC PIECE OF TICKER TAPE



Many shares of stock were traded the day after the attack on Pearl Harbor. In the first transaction, 200 shares (2s) of Pennsylvania Railroad (PA) sold at $20 each (20). If 100 shares are traded, no number is given; for 1,000 or more shares, the number is written out. Other sales involve Consolidated Edison (ED) at $13.75; B. F. Goodrich (GR); Standard Oil of New Jersey (J); E. I. du Pont (DD); General Mills (GIS); American Telephone and Telegraph (T); and United Aircraft (UR).

As a guide to the trend of the stock market—whether prices are going up or down—various organizations compile market averages. The most widely known is the Dow-Jones average. It is compiled by Dow, Jones, and Company, which publishes the *Wall Street Journal*, a daily newspaper devoted to business and finance. The market average that is best constructed statistically is that of Standard and Poor's Corporation. The *New York Times* also compiles an average which is frequently used by market analysts.

Because the New York Stock Exchange is located on Wall Street, the term "Wall Street" has come to mean finance—the issuance, sale, and trading in securities. Certain Wall Street terms have become a part of the language. A "bull" is someone who expects prices to advance. A "bear" expects prices to fall.

The term "bear" is often associated with *short selling*. In selling short a person sells a stock he does not own in the expectation of a price decline. He gives the purchaser a stock certificate borrowed through a broker. Later he will buy the stock to return the shares he borrowed. If he can buy below the price at which he sold, he makes a profit.

When stock cannot be borrowed—when no shares are available—the bears are said to be "cornered." The most famous corner occurred in the fight between James J. Hill and Edward H. Harriman for control of the Northern Pacific Railroad in 1901. Both sides bought so many shares of the railroad that the stock climbed from a price just above $100 a share to more than $600. Speculators felt it was too high and sold it short, but the two principals were buying the stock "for keeps." Thus the "shorts" could not borrow the stock. As the shorts sold other securities to cover their Northern Pacific commitments, Wall Street was thrown into a financial panic. Finally the shorts who could not get stock were allowed to settle their sales for $150 a share. Today the Stock Exchange reserves the right to suspend trading in stocks in which the supply has become inadequate. This is a safeguard against cornerers.

A well-known Wall Street jingle is associated with short selling:

> He who sells what isn't his'n
> Must buy it back or go to prison.

Short selling has been blamed for speeding up and prolonging stock market declines. It is now strictly regulated by stock exchanges and the Securities and Exchange Commission to prevent "bearing" the market for profit through manipulation.

Reading the Financial Page

Newspapers in many big cities report the prices at which listed stocks and bonds sell. Each newspaper generally prints the name of the company, the dividend, the number of shares traded (sales), the high price at which the stock sold, the low price, the closing price, and the net change for the day's trading. A typical line in a stock table might look like this:

Stock	*Div.*	*Sales*	*High*	*Low*	*Close*	*Net Chg.*
XYZ	$2	15	38⅛	36	38	2

This stock is that of an assumed company—the XYZ corporation. Indicated after the name is the dividend rate of $2 per year. There were 1,500 shares traded—the 00 is omitted. The stock reached a high of 38⅛, sold at a low of 36, and the last price was 38. The net change from the closing price of the day before was a gain of $2 per share. Sometimes newspapers also print the opening prices at which stocks were traded and the range—that is, the high and low prices for the year.

Bonds are also listed by name, together with the interest rate and the maturity date. For example: XYZ 4½ '62. Bond prices are quoted in points, each point equaling $10. Thus a bond which sold for $1,025 would be quoted as 102½. Government bonds are quoted down to the thirty second of a point instead of the customary one eighth. The buyer of a bond pays the seller the purchase price plus accumulated interest. Income bonds are traded "flat"—without accumulated interest.

The actual prices paid for over-the-counter stocks are not printed because these transactions are private. Dealers supply newspapers with bid and asked prices. For example: QR 46–48 means that a dealer is bidding $46 for QR stock and will sell for $48 a share.

To announce prices of securities quickly some stock exchanges have ticker services which transmit sales prices directly from the trading floor to brokerage offices and newspapers. Bond prices are similarly transmitted. The most widely used ticker service is that of the New York Stock Exchange.

Protecting the Investor

Securities can be purchased by borrowing part of the purchase price. This is "buying on margin"—margin being the amount of money the buyer puts up. The rest is supplied by a bank or broker. The percentage of money which can be borrowed on listed stocks is regulated by the Federal Reserve Board. The lender holds the securities purchased on margin as security for the loan. If prices decline, the lender may call for more margin or collateral. If the borrower cannot supply it, the lender then will sell the stocks. Excessive margin buying and forced liquidation were big factors in the 1929 stock market crash.

To protect investors against abuses, Congress passed the Securities Act of 1933 and the Securities Exchange Act of 1934. The Securities and Exchange Commission is the enforcement agency. Corporations must publish all the facts when offering securities for sale, including a record of past earnings, the officers' salaries, and the purpose of the financing. Trading on registered exchanges and on over-the-counter markets is regulated. Investment dealers, who recommend securities to investors, must disclose whether they have an interest in these securities. Misrepresentation, manipulation, and pool operations are punishable by fine and imprisonment.

The laws do not prevent true speculation—the purchase of a security in expectation of a profit. They do, however, tend to prevent persons with inside or special knowledge from taking advantage of others who do not have that knowledge.

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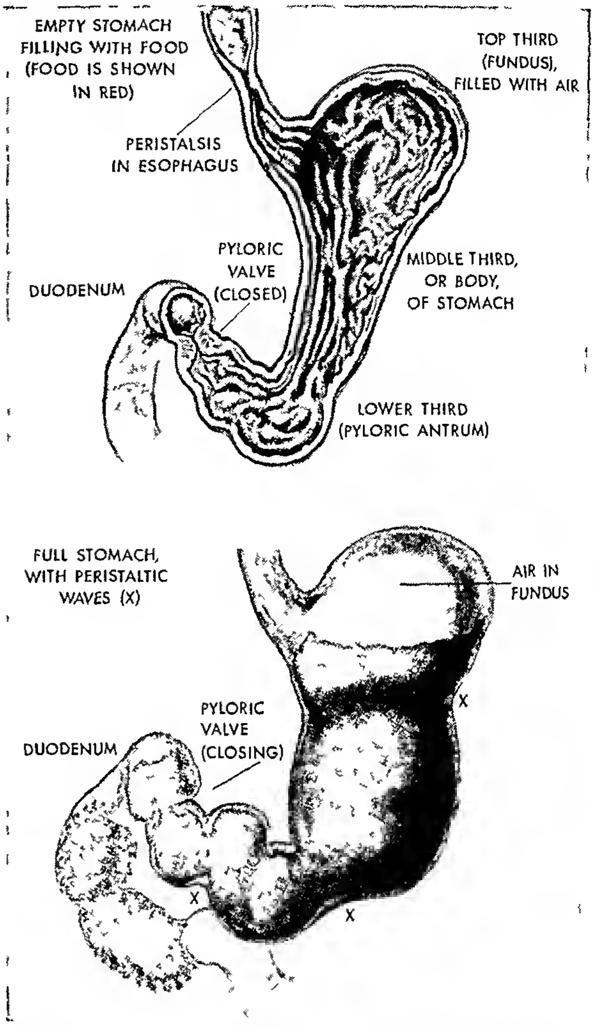
THE STOMACH EMPTY AND FULL



These two views of the stomach were drawn from X-rays. The top picture shows the interior structure of the empty stomach, with many folds in the lining. The bottom picture was drawn as though the wall of the full stomach were transparent.

STOMACH. In 1752 the French scientist René Réaumur fed his pet bird small pieces of sponge. The bird, unable to digest the sponges, ejected them. Réaumur squeezed out the stomach juices soaked up by the sponges and tested their dissolving action on meat. This was the first real demonstration of how food is acted upon by juices in the stomach.

The stomach is located in the upper part of the abdomen just under the heart. It is a pear-shaped muscular sac. Food reaches it through a transport tube called the *esophagus*. Muscles in the walls of the esophagus expand and contract in wavelike movements to force the food along the esophagus and into the stomach. These wavelike muscular movements take place throughout the digestive tract. This action is called *peristalsis* (*see* Digestion). In the stomach peristalsis churns the food into small particles and mixes them with gastric juices secreted by glands in the stomach lining. These juices break down food into the simple forms which the body can use.

Glands in the upper two thirds of the stomach secrete the digestive juices, or *enzymes*, called *rennin* and *pepsin* (*see* Enzymes). Rennin curdles milk so that its solids are separated from its liquids. Pepsin begins the digestion of protein. Upper stomach glands also secrete *hydrochloric acid*, which helps break up meat fibers and other foods. Glands in all parts of the stomach lining secrete mucus, a slippery whitish fluid which covers the particles of food with a slimy, smooth surface. In this condition, the particles move more easily into the small intestine. (For picture of glands in color, *see* Digestion.)

When the human stomach is empty, it is a narrow tube swollen at the top by a bubble of air as shown in the pictures on the opposite page. The walls are elastic, and as the stomach fills with food and liquid the walls expand until the organ is more like a bag than a tube. The stomach of a newborn baby is the size of a small chicken egg and will hold about one ounce. In adults the stomach is 10 or 11 inches long and 4 to $4\frac{1}{2}$ inches in diameter when full. It has a capacity of a little more than a quart.

Only the diaphragm, the muscular wall between the chest and the abdomen, separates the heart and the stomach. For this reason too much air in the stomach may cause discomfort which may seem to be a pain in the heart. The stomach is more or less vertical. Its shape, size, and position vary in different people.

Where the esophagus joins the stomach and where the stomach joins the top part of the small intestine (the *duodenum*), there are ringlike muscles which act as shut-off valves. These muscles are called *sphincters*, from a Greek word meaning "to bind tight." The sphincter valve between the esophagus and the stomach keeps food from being pushed back into the esophagus by the food-churning movements of the stomach. The sphincter valve, or *pylorus*, between the stomach and the small intestine controls the rate at which the partially digested food, called *chyme*, is moved into the small intestine. (*See* Physiology.)

How Cows' and Birds' Stomachs Differ

Some animals which eat plants—called *herbivorous* animals—have more parts to their stomachs than man and meat-eating animals. The cow, for example, has four sections in its stomach. The cow swallows food whole, which enters one part of the stomach. Later the cow forces the softened food, called a "cud," back into its mouth where it is chewed. The food is again swallowed into a second stomach chamber, then moves on into a third, and finally a fourth chamber, in each of which further digestion takes place (*see* Ruminants).

The bird's stomach has two parts. In the front part, called the *craw*, gastric juices soften the food which the bird has swallowed whole. The back part of the stomach, called the *gizzard*, has strong muscular walls. Birds swallow pebbles which remain in the gizzard. The strong muscles enable the gizzard to expand and contract, grinding the food.

STONE AGE

Stone age. Before men learned how to work with metal they made their cutting tools and weapons of stone. The American Indians used stone implements until the white men came. Some backward peoples today—such as the Australian bushmen—are still living in a Stone Age culture. The term "Stone Age," therefore, does not refer to a particular period of time, but to a stage of civilization (*see* Man). The timetable worked out for the civilization of western Europe is often used as a scale in measuring the progress of prehistoric peoples elsewhere.

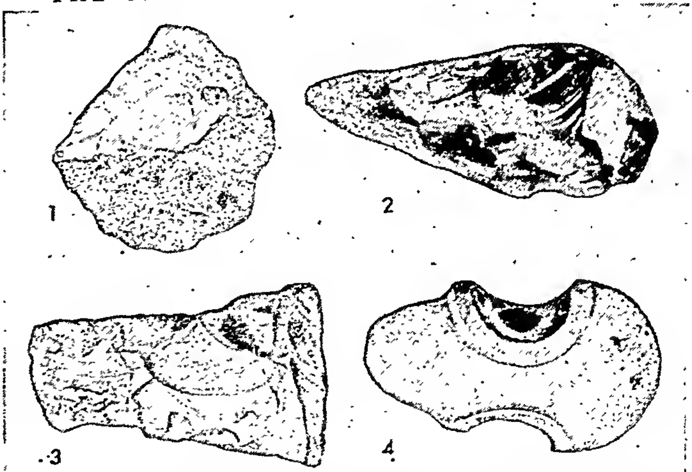
The Old and the New Stone Ages

The Stone Age began when men learned that certain stones broken by a blow would produce a sharp cutting edge. These broken stones were given various useful shapes by knocking off little chips. Thus they made knives, scrapers, borers, picks, and axes. Such chipped-stone implements are called *paleoliths*. The early period when they were used is called the *Paleolithic*, or *Old Stone, Age*. Flints over a hundred thousand years old have been found fashioned with great care and delicacy as if the maker wanted an implement that was not only useful but beautiful.

Tools of chipped stone served well enough for hunting but they were not good tools for handicrafts. Eventually men learned to grind the chipped stones smooth. Tools and weapons of smoothed stone are called *neoliths*, and the stage in which they were used is called the *Neolithic*, or *New Stone, Age*. With this improvement in equipment came the cultivation of grains and cultural advances such as pottery making and weaving (*see* Civilization).

About the end of the New Stone Age in western Europe, some people set up monuments of huge stones. Some of these (*menhirs*) are single massive stones. Others consist of two stones set upright and capped by a third (*dolmens*). Even more elaborate are circles or squares of huge stones (*cromlechs*). The

THE CAVEMAN'S TOOLS AND WEAPONS



1. This crude "paleolith" was roughly chipped to produce a cutting edge. 2. Smaller chips were flaked off to shape this sharp-pointed tool. The round end was gripped in the hand. 3. This axhead could be inserted into the split end of a stick and lashed in place with a strip of hide. 4. A hole for a handle has been bored in this streamlined mallet of the Neolithic Age; carefully shaped implements of this kind testify to a great advance in technical skill.

most famous of these remains are Stonehenge, near Salisbury, England, and the monuments near Carnac in France. Others have been discovered in northern Africa, India, and South America. Ancient graves have been found on the sites of many of these Stone Age structures. Some of the stone circles, notably Stonehenge, seem to be laid out so that they line up with the rising sun on the day of the summer solstice. These facts lead archeologists to think that the structures served as primitive temples.

STORK. In Europe the stork is believed to bring good luck, and when a child is born people say they have had "a visit from the stork." Many a householder used to erect on his chimney or roof top a wooden platform or cart wheel to encourage the bird to build its nest there. The common stork is found only in the Old World, and is known to Americans chiefly through German and Dutch stories and folklore. The only member of the stork family in North America is the wood ibis.

EUROPEAN STORKS PREFER A HOUSETOP

This photograph of a stork family was taken in Breslau, Germany, now in Poland. With a little good-natured crowding the family manages to settle down for a sound night's sleep. The nest of reeds and sticks is quite new. Each year the two older storks will add to it until it is several feet high.

Storks are large clumsy birds. Their bills are long and heavy, and very stout at the base. Head and neck are bare of feathers. Like the cranes, they fly with neck and legs outstretched. They feed on insects, frogs, fish, and mice, which they gather in marshes and meadows. They return year after year to the same nest, either on roof top or treetop, adding each season to the pile of sticks until the platform becomes several feet high. The stork has no voice, and during the mating season, when other birds express themselves in song, it goes through a grotesque stiff-legged dance, leaping from the ground with extended wings flapping wildly, and making a clattering noise with its bill.

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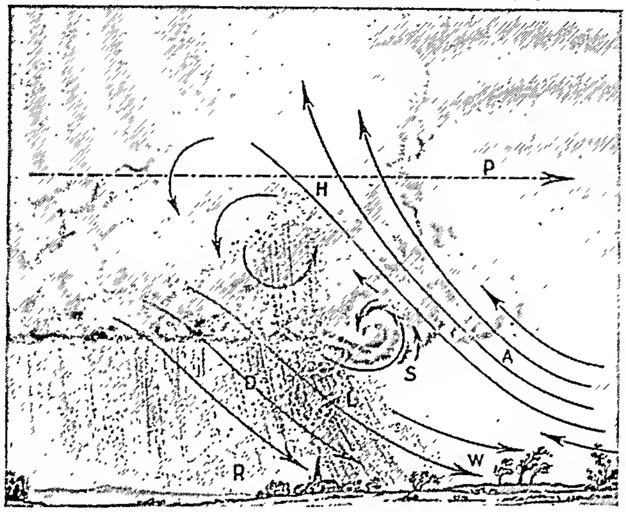
HOW A THUNDERCLOUD ACTS



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most famous of these remains are Stonehenge, near Salisbury, England, and the monuments near Carnac in France. Others have been discovered in northern Africa, India, and South America. Ancient graves have been found on the sites of many of these Stone Age structures. Some of the stone circles, notably Stonehenge, seem to be laid out so that they line up with the rising sun on the day of the summer solstice. These facts lead archeologists to think that the structures served as primitive temples.

STORK. In Europe the stork is believed to bring good luck, and when a child is born people say they have had "a visit from the stork." Many a householder used to erect on his chimney or roof top a wooden platform or cart wheel to encourage the bird to build its nest there. The common stork is found only in the Old World, and is known to Americans chiefly through German and Dutch stories and folklore. The only member of the stork family in North America is the wood ibis.

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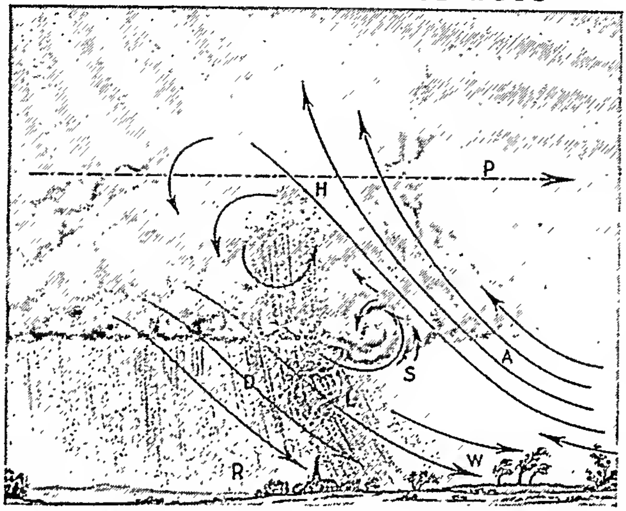

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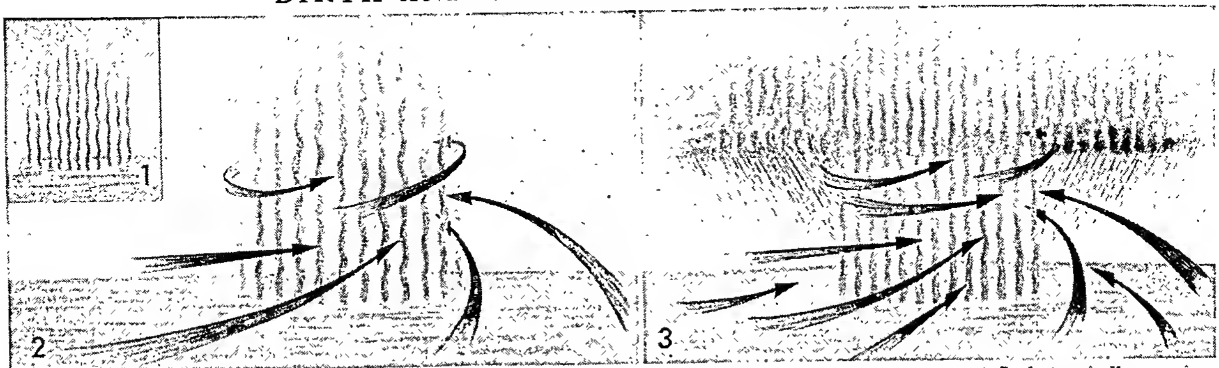
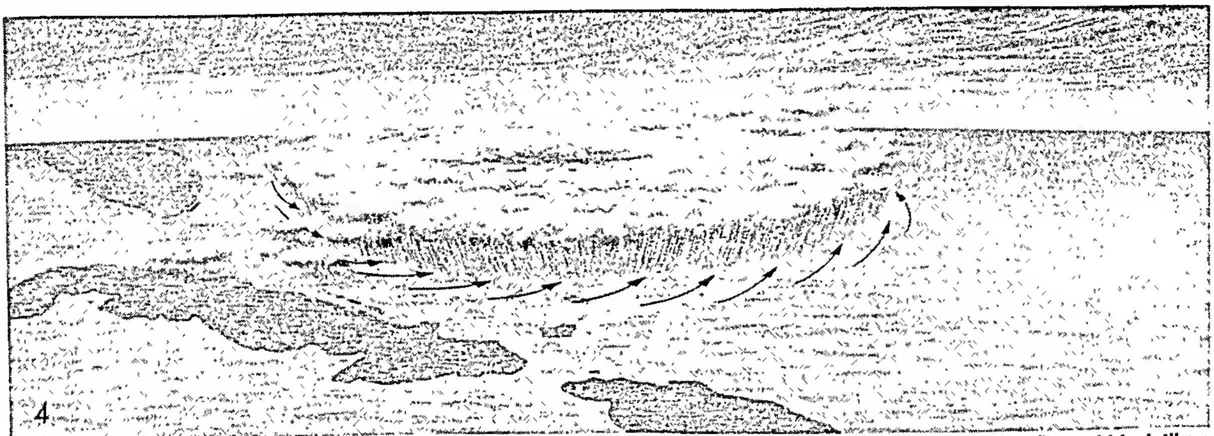
BIRTH AND GROWTH OF A HURRICANE



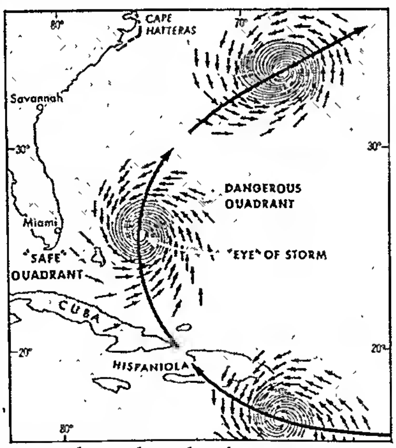
Scientists do not understand hurricanes fully, but the following processes probably help to form them. 1. In hot, windless regions (the doldrums) near the equator, strong updrafts of heated air develop over oceans. 2. Cooler air flows in to replace the rising air. As this cool air moves in, the earth's rotation makes it drift to one side (*right* in the Northern Hemisphere). This gives a whirling motion to the whole mass. 3. Moisture brought by the cool air condenses to rain and gives up heat, thus adding to the updraft.



4. A hurricane over the Bahamas might look as shown above, if seen from a point many miles above the earth. It would look like a huge pancake-shaped mass of storm cloud wheeling in a counterclockwise direction around a calm center (called the "eye"). Extending many miles above and beyond the storm is a high veil of cirrus cloud. This gives warning that a hurricane is coming.

baguio is used. (The word "hurricane" is also used for any wind that blows more than 75 miles an hour.)

Hurricanes do terrific damage on land and at sea. They cause waves which sometimes flood cities and take many lives. When such storms arise in the West Indies, they start west with the trade winds. But, like all great air movements in the Northern Hemisphere, they are deflected to their right. This is called *recurving*. Thereafter they move across the Caribbean Sea, turning eastward or northeastward into the Atlantic Ocean.



This shows how hurricanes *recurve* in moving out of the tropics. Mariners try to avoid the right front (dangerous) quadrant, where winds are strongest.

Forecasting Hurricanes

Mariners and others foretell hurricanes by well-known signs. First come dull red sunsets, caused by a thin haze of clouds. The air becomes hot and sticky. The barometer is high and the wind dies. At sea there is a growing swell. As the storm draws near, the barometer drops suddenly. A rain cloud rushes forward from the horizon. Then a deluge of rain fills the air, while the wind blows with hurricane force.

The direction of the winds in a hurricane is often stated as a rule called the *law of storms*. Ship captains can avoid the dangerous central region of low pressure by steering so the wind blows from the starboard (right) in the Northern Hemisphere, and from the left in the Southern. The ship then sails out toward the edge of the storm. Sometimes a ship passes into an area of little or no wind and then runs into the storm again. The deceptive calm was the center (called the "eye") of the storm.

Meteorologists do not understand clearly how tropical cyclones get their start. One theory of their formation is illustrated on this page. The power that keeps them going probably comes from heat released when moisture is condensed to rain within the storm. This heat keeps air pressure low at the center of the storm, and, while low pressure persists, the storm continues. If a storm leaves the ocean and moves inland, it usually dies down; it seems to need moisture from an ocean to keep it going.

A NEBRASKA TORNADO CAUGHT IN ACTION

Noting an unusual storm approaching, a photographer in David City had his camera ready and was rewarded with this perfect picture of the funnel-shaped tornado, or "twister," which swept over his town causing much damage. Notice how the bottom of the funnel is above the ground, rather than touching it. This tip will be above tree tops at times, and an instant later will touch the ground. Like other states of the Great Plains region, Nebraska is often visited by such storms.

The ART *of* STORYTELLING *and the* STORYTELLERS

"It's the loveliest house I ever saw," gasped Gretel, "and it looks good enough to eat." Drawing by Wanda Gág from 'Tales from Grimm'. (Coward-McCann.)

STORYTELLING. The art of storytelling is as old and as spontaneous as dancing and singing. As soon as man began to travel he carried with him the songs and tales he knew, and the story of their passing from India through Persia and Arabia to the civilized countries of Europe is one of the most fascinating records in human progress as it is in the history of literature.

> Whoever learns the book by heart,
> Or through the storyteller's art becomes acquainted,
> His life by sad defeat—although
> The King of Heaven be his foe—
> Is never tainted.
>
> —'The Panchatantra'

Stories are as sensitive to climate, soil, and cherishing care as plants and animals and human beings are. Some stories need the warmth of their native land for their meaning and very existence. There are stories which cannot be transplanted from the countries in which they originated, and for enjoyment of them we must rely upon the storyteller's magic to transport us in imagination to those countries, where we can see them in their original setting.

There are stories which readily take root and flourish all over the world with variations characteristic of the countries in which they are found. Collecting stories which belong to different countries is as fascinating a hobby as collecting coins or postage stamps, provided one has had early and familiar acquaintance with story literature in versions which have been taken from the lips of native storytellers.

The selection of picture storybooks and songbooks for the first three divisions of the list accompanying the article Libraries has been made with a view to providing the elements of story literature. Song and dance, story and picture belong together in early childhood of the present day even as in the childhood of the race. Now as then, stories may be sung as well as told in the firelight in the open or at home. There are families in which mothers and fathers, grandmothers and grandfathers have been accustomed for generations to share their store of old rhymes and ballads, singing games, nonsense verses, and rhythmic tales. And when, as sometimes still may happen, the storyteller is accompanied by the harp, or by the guitar, the ancient art takes on new meaning in the life of a family or a community which has grown accustomed to look upon storytelling as a method of teaching rather than as an art in itself.

Of incomparable value to any system of teaching, the story must remain forever free of didactic application. In the East, while regarded for centuries as the touchstone for a whole system of ethics, the story has never lost its appeal as drama—drama in which the actors are usually animals with human characteristics. A modern popular translation of 'The Pan-

chatantra' (The Five Books) from the Sanskrit reveals to the general reader as well as to the scholar the wit and wisdom of stories and epigrammatic verses recorded more than 2,000 years ago "to set forth the wise conduct of life."

'The Panchatantra' contains the most widely known stories in the world, gathered under five heads —The Loss of Friends, The Winning of Friends, Crows and Owls, Loss of Gains, Ill-Considered Action. Arthur Ryder, who has made this delightful translation, speaks of it as one of La Fontaine's important sources. The collector of stories will find in it many a familiar tale, and the parent who is seeking wise guidance in establishing social relationships will take from it many suggestions as applicable to the wise conduct of life in the present day as in the year 200 B.C. Many of the stories contained in 'The Panchatantra' lie quite outside the experience and imaginative interest of children, and this is also true of the Bible, 'The Arabian Nights', as well as all great source books of stories not originally intended for children.

Quality of the Wording Important

The wise storyteller will choose only those stories which he feels reasonably certain he can bring to life by his own power to recreate. Mary Gould Davis, who included the story of 'Numskull and the Rabbit' in a collection of stories she had told to many groups of children, said: "That the wit and wisdom of these old tales strike home to the minds of boys and girls is proven by their faces when the story is told that is given here in this book. It is not only the action and characters that appeal to them. It is the words themselves. The wording of these stories, in Mr. Ryder's translation, is a vital part of them."

Miss Davis, whose rich experience as a storyteller led her to comparative studies of folk literature, herself translated a selection of stories from the Italian in words so well suited to the tales as to suggest that the translator has heard them told in their own country. It is by this quality of spoken language that the best version for the storyteller's use is determined. The language in which a story is told is as important as the subject matter. It must belong unmistakably to the tale to be told rather than the book to be read. Book language does not stick in the memory nor does it make "the happening" seem real. At no period in life is one so sensitive to the sound of words or so susceptible to the picture-making possibilities of words as in early childhood, when every child is a potential storyteller and language itself a thrilling adventure.

A Storyteller of Ireland

In 'The Fountain of Youth', Padraic Colum has pictured the storyteller of his own youth telling his stories by the light of a peat fire in a language that had not been written down. "He had words," says this Irish poet and student of the myths and legends of many lands, "that had not been made colorless by constant use in books and newspapers. He was free to make all sorts of rhymes and chimes in the language he used." Out of golden memories of tales thus heard in childhood, to the rendering of which he brought the full power of his racial imagination, Padraic Colum first told to children in another land, before writing them down, his stories of 'The King of Ireland's Son'. "I never see the printed page in reading my own stories or poems," says Mr. Colum; "literature first came to me orally."

The Gammer Grethel, whose accurate memory and genius for storytelling provided the Brothers Grimm with so many of their well-known fairy tales, must have possessed intuitive understanding of the value of words in the preservation of a tale, for philologists though the Grimms were, they wrote down the stories she told them in her words rather than their own. The publication of the first translation of these stories into English and the illustration of them by Cruikshank (1823) may be regarded as a landmark in preparing the way for a revival of storytelling as an art. Hans Christian Andersen was to become the moving spirit in this art in the 19th century and the inspiration for a wider application of it in the 20th century.

Andersen not only delighted children with the stories he remembered hearing as a child, but with many others of his own invention. He carried the story personally back into the courts of Europe and charmed kings and queens and emperors with fresh tales of the follies of royalty. Andersen took the story into the theater, which had rejected him as an actor, revealing it as drama in miniature with all the world for its stage. And it was Andersen who demonstrated to story writers and storytellers from his day to ours that stories for children may be spun out of anything under the sun or the moon, provided the conception of the storyteller is equal to the dramatic requirements of his art.

When the curtain goes up on the story, the story must be there as surely as the play. It is impossible to estimate the value of Andersen's contribution to story literature and to the art of storytelling. To him more than to any other personality may be attributed the release of the play spirit in literature which has characterized the best original writing and the best retelling of stories for the past hundred years. Andersen revealed one of the primal needs of childhood, that of investing the inanimate with life.

Famous Names in the Art

Contemporaneously with the creation of a new imaginative story literature for children by Lewis Carroll, George Macdonald, Rudyard Kipling, and Frank Stockton, there appeared new collections, fresh translations, and vigorous retellings of folk tales, myths, legends, and epic tales designed for boys and girls whose appetite for stories does not diminish if well fed, but requires stronger meat in the years just preceding the teens. Thanks to Asbjörnsen and R. B. Andersen in Norway, to Sir George Dasent, Andrew Lang, and Joseph Jacobs in England, to Douglas Hyde, William Butler Yeats, and Lady Gregory in Ireland, to Hawthorne, Sidney Lanier, Horace E.

Scudder, Frank Cushing, George Bird Grinnell, Howard Pyle, and Joel Chandler Harris in the United States, English-speaking children were fairly well provided with good storybooks by the end of the 19th century. But far too many of these books remained undiscovered by boys and girls who had acquired the mechanics of reading, but not the love of it.

The 20th century brought many changes, and none more prophetic of a new day than the revival of Old World dances in city streets and parks and community houses of the New. The great out-of-doors movement, with its games and sports for everybody, its campfire, and the woodland ritual derived from native Indian lore for boys and girls, was under way. The fairy tale had come back into the theater with 'Peter Pan', and a fresh wave of interest in the drama and in children's plays was sweeping over the country. "The play's the thing" was being incorporated into educational doctrine.

"There came a soldier marching along the highroad—one, two! one, two! . . . And on the way he met with an old Witch . . ." Drawing by Elizabeth MacKinstry from 'Andersen's Fairy Tales'. (Coward-McCann)

The tide of immigration which continued to flow through the United States from countries of the Old World was bringing living streams of story and song to enrich and enliven educational methods and social relationships. But not until language barriers were set aside by kindergarten, social settlement, civic playground, and public library was this fine inheritance of vitalizing literature made available for children of many races who were expected to grow up in a new country with a love of its language and regard for its traditions. The practise of storytelling as a means to this end, without loss of spontaneous joy in the story, has not been confined to any one institution or locality. The idea apparently presented itself simultaneously to a number of people in different parts of the country and met with enthusiastic response.

The children's department of the public library, then in its infancy, provided a logical center for storytelling, since it was organized not merely to serve as a repository for the literature which belongs to childhood and youth, but to interpret and evaluate that literature to the community.

The Carnegie Library of Pittsburgh was the first library in the country to establish a weekly story hour for children and, after some experimentation, to accord it a high place as a method of guidance of children's reading. Both its printed lists and its programs of stories have been widely used by schools as well as by public libraries and storytellers.

Marie Shedlock's Influence

Storytelling was already in the air when Marie L. Shedlock, a professional storyteller, well known in educational and dramatic circles in England, first came to America to give French monologues and tell Andersen's fairy tales to children and to grown people. The response to her art and to her inimitable interpretations of the poetry and philosophy, the wit and humor of Andersen was immediate. From Boston to San Francisco, and from Montreal and Toronto to St. Louis the stories she told and the way she told them are still remembered. Miss Shedlock returned to tell stories and to give instruction in the art of storytelling to students in training to become children's librarians and teachers until she was recalled by the London County Council in 1907 to take back to the teachers of England the inspirational value of her storytelling experience in America. She is probably the only woman who has ever told stories at Rugby and other boys' schools in England. In 1915 Miss Shedlock was recalled to America by a committee of representative women in New York and remained to tell stories throughout the period of the war. To the inspiration of this gifted storyteller the public libraries of New York and of Boston owe the establishment of storytelling hours, which have not only extended the range and improved the quality of reading done by foreign-born and native American boys and girls, but have been accorded a definite place in the life of those cities ever since.

A Storyteller of Norway

Gudrun Thorne-Thomsen brought a rich inheritance of Scandinavian literature and dramatic art to her work in the United States as a teacher of literature

and storytelling. When a unique civic experiment was undertaken in Chicago in 1910, Mrs. Thorne-Thomsen was persuaded to give demonstrations of storytelling in the field houses of the public recreation centers. The Chicago Public Library, then just beginning its system of branch libraries, took an active part in the co-operative experiment.

Since the prediction then made by Mrs. Thorne-Thomsen regarding the future of storytelling has been borne out by results wherever organized programs have been undertaken and sustained, her words are pertinent: "I believe that the purposes of storytelling are best served by the storyteller being an integral part of the organization she serves. I believe that if the organizations which express themselves sympathetic toward the work would co-operate and give definite instruction to their workers and would also give them a fair amount of supervision and direction the whole movement might be placed on a dignified and wholesome basis."

Mrs. Thorne-Thomsen's instruction in the art of storytelling at the Cleveland Public Library and at the Carnegie Library of Pittsburgh was for many years the inspiration of gifted students who became storytellers and instructors in the art for those cities and other communities throughout the country. Fortunately, recordings of Gudrun Thorne-Thomsen's Norwegian folk tales assure the permanence of her contribution as an artist and set a high standard for future recordings of storytelling.

Today storytelling is an important feature in the work of children's departments of public libraries in the major cities. In many smaller communities, a trained children's librarian conducts an excellent storytelling program.

The National Story League

The National Story League was organized in 1903 by Richard T. Wyche on the campus of the University of Tennessee. Mr. Wyche, a lecturer and storyteller with a strong conviction of the value of storytelling as a social service and a personal experience, was a natural leader of a spontaneous revival of the art in the South. He was president of the League for its first 16 years.

During that period Mr. Wyche made the League widely known by his lectures and writings. The first Story League formed after the organization was at Selma, Ala., the first Junior League at Corinth, Miss. *Story Art*, the official publication of the National Story League, is published at Dallas, Tex. The Year Book issue of this bimonthly magazine contains a roster of Story Leagues and Junior Story Leagues.

How to Tell a Story

THE ANCIENT challenge for a story has gone unanswered in far too great a measure. This is true especially in small towns and rural districts, where for generations boys and girls have never heard a story told. This need not be so. Wherever there may be a small library, a school, a community center, a scout troop; wherever there may be a librarian, a teacher, a leader, or parents—there can and should be story hours. For example, recently in Maine groups of high-school students have been going into isolated districts to tell stories in the small one-room schoolhouses. They have been guided by an experienced storyteller and have discovered for themselves as well as for their listeners the fun and enthusiasm that lie in good stories.

To learn something new is stimulating. To learn by one's own effort, by the older and perhaps the best method in the world—trial and error—is equally stimulating. A beginner need not be fainthearted. For the beginner in storytelling here are two primary facts that may provide a springboard. First, everyone is a potential storyteller; everyone receives that racial heritage passed on by the traditional storytellers. Second, whether one be conscious of it or not, nearly everyone has been telling stories since he learned to talk.

Children and adults have continually felt the urge to tell stories about themselves, about the books they have read, about the plays or motion pictures they have seen, about something they have heard over the radio. Both the urge to tell and the ability are ingrained in us. Taking off from here it would be well to mark those factors in storytelling which are of most importance to the beginner.

Building Voice and Vocabulary

Every art requires its special tools and mediums for expression. For a storyteller these are a pleasing voice and a certain skill in and appreciation for the use of words. The only way to be sure one has a pleasant voice is to acquire a listening ear. One must be able to hear one's own voice as well as other voices; one must learn to mark, to compare, to arrive at some standard by which to judge a voice. Is it well pitched—not so high as to be thin and shrill, not so low as to be mumbling? Is it a flexible voice? We all know how dull and uninteresting a monotonous voice can be. Is there good breath control? This means a voice may be pulled out of the throat and placed on the diaphragm where it belongs. A throaty voice tires easily; it does not carry well. A few simple exercises in breathing, the practice of speaking vowels and words on the breath, can add strength, clarity, and a pleasing tone to voices that may at the start be not too pleasing.

As for the use of words—they are for the storyteller what notes are for the musician or colors for the artist. A good, well-rounded vocabulary is a rich possession. It is out of words that storytellers create those pictures that captivate the listeners; for it is through the medium of pictures that the story is told and gathered in by the listeners. Words should be strong, of simple meaning; they should have color and that quality which arouses the imagination. Children take a peculiar delight in the sound and flavor of

words. They enjoy strange words if there are not too many of them used too often. Anything unfamiliar in a story should be explained before the story is begun. Never break the magic of a story by stopping in the middle to explain.

What Makes a Good Story?

It is important to have some understanding of what makes a good story to tell. Nearly all the stories included in what we call folk literature make for good telling. Nursery and fairy tales, myths, legends, and hero tales hold a universal appeal (*see* Folklore; Mythology). They have simple and strong language and their form is closely knit, usually around a single idea or plot. The ones that can be told on the "short breath," as the French say, are the best for the beginner. The introduction in the story should be short, but it should arouse that sense of anticipation which makes the listener eager for what is going to happen. The development, or action, in the story should be logical, step by step. Once the climax is reached the ending, or fulfillment, should come quickly; it should satisfy, and it should seem the right and only ending for that particular story.

In the main a good story should appeal to those emotions that are felt to be both true and desirable in childhood: humor, love of adventure, desire for courage, compassion, a sense of good fellowship, joyfulness, and fresh untrammeled imagination. It is of such substance that good stories are made.

How to Prepare a Story

What inevitably concerns the beginner is the best way to memorize a story. To learn word by word is both tedious and difficult. This form of memorizing tends to make the story mechanical; too often it gives the impression of a recitation. True storytelling should have qualities of spontaneity and freshness. A musician re-creates his music each time he plays it. A dancer re-creates what she dances. So with the storyteller—the story should be re-created each time it is told; it should come to each listener as a living experience; it should hold the immediacy of something that is just happening. Even a beginner can make what she tells seem spontaneous, newly created if she never allows the story to become mechanically repeated, over and over, while it is being learned.

It has already been stressed that stories come to both the storyteller and the listener in the form of pictures. It is as a series of pictures that a story should be memorized. Let it be read slowly, letting the picture of each character and event be formed naturally in the mind. Close the book and think the story through in terms of those pictures the mind—or imagination—has made. Then read the story again for the language. With two or three readings it is amazing how words fit themselves to the pictures and the story takes form. We all know what a strong hold pictures take on both imagination and memory. Stories memorized in this way are never forgotten; they belong to the storyteller; she can trust them, tell them with enthusiasm and authority.

That this way of memorizing by pictures may be more readily understood, here is a concrete example. The story used is 'The Bremen Town Musicians' taken from the tales of the Brothers Grimm (*see* Grimm). It is a great favorite with children. Here are the pictures as they form themselves naturally in the mind of any storyteller:

An old ass, or donkey (American children are more familiar with donkeys), is the first character to be introduced. All his life he has worked hard. Now that the donkey is too old to work his master has turned him out.

He takes the road to Bremen. He will become a town musician. On the road he falls in with Growler, the old dog, also abandoned.

Together they travel and meet up with Whiskers, the old cat. No longer able to catch mice, the cat is going to be drowned by her mistress.

They come to a barnyard. Here on a post they hear the old cock bemoaning his fate. He has failed to crow fair weather for Lady's Day, so he is to be served up for the holiday dinner.

The donkey persuades them all to come with him to Bremen and form a band. Their spirits rise. They are no longer outcasts.

That night they take shelter in the woods. The cock and cat go up a tree, the dog and donkey lie down under it. Aloft the cock spies a light. It may offer better shelter.

Making their way through the woods the four find a barn where robbers are hiding. They are feasting around a table.

"Good fare for us," announces the donkey. It is time to start being town musicians. On the donkey in turn mount dog, cat, and cock. Together they bray, bark, caterwaul, and crow.

Terrified, the robbers flee. The four take over the barn. They feast, then settle themselves for the night, each in his accustomed place.

The robbers return. One of them attempts to discover what has happened. While he tries to find his way in the dark the cat scratches him, the dog bites him, the cock claws him, the donkey kicks him. More terrified than before he tells the others that witch or devil has taken over their hiding place. That is the last of the robbers.

The four, left in peace, end their days in comfort and plenty.

'The Bremen Town Musicians' illustrates every point in a good story: it is short; language is simple; introduction is brief; it develops logically; the ending follows quickly upon the climax; and it satisfies. The story has a single central theme. Beginners will find it easy to learn and delightful to tell.

Sources of Good Stories

The transition for the beginner from the simple, unified folk tale to the more complex story by a fine author should not be too difficult. Stories should be told from such writers as Rudyard Kipling, Eleanor Farjeon, Elizabeth Coatsworth, Henry Beston, Laura Richards, Beatrix Potter, Parker Fillmore, Seumas

MacManus, and Wanda Gág. Such a story as Wanda Gág's 'Gone Is Gone' makes a perfect and easy transition from the simple to the more complicated form of story.

Furthermore children's books should be "told from"; to tell just enough from the beginning of a good book whets the appetite for more. It invites those who are poor or slow readers to do more reading on their own account; it helps them to discover books on their own terms. So often it happens that boys or girls, thus invited to read a book through for themselves will go to the librarian and ask for another book "just the same kind." Thus will wider reading interest grow; and that is good. (*See also* Literature for Children; Reading.)

Last Things to Remember

There is a final point in storytelling that needs emphasis—the matter of timing. This is as important in the art of storytelling as in that of music, dancing, or the theater. Think of what a dreary, stupid performance it would be if a whole symphony were played through at the same tempo; if lines throughout a play were given at the same speed; if a dancer never changed her rhythm, never broke it with a moment's pause.

So with a story. There are moments which call for slow, leisurely telling. As the action grows, as things begin to happen, it is natural to hurry the tempo. Before a moment of awe, of rising wonder, of excitement, a pause can add much to the tang and flavor of a tale, and a storyteller gets far more fun out of the telling when she has learned to use timing effectively.

Here is a summary of those things of value that may lie in the art of the storyteller for the beginner:

To remember that storytelling is a part of our racial heritage.

To remember that nearly everyone is a potential storyteller.

To learn to listen to voices, including one's own, and then to mark what makes a pleasing voice: the right pitch, flexibility, breath control, clear enunciation.

To realize the importance of words—to use them richly, with strength, meaning, and power.

To know what makes a good story for telling: one with a single idea or plot, a short introduction, a logical development, the ending following closely on the climax. A good story uses simple language, holds a universal appeal.

To memorize a story by pictures.

To be conscious of the value of timing and to use it effectively.

Books about Storytelling

The Art of the Storyteller. By Marie L. Shedlock. (Dover.) The clearest and most readable exposition of storytelling as an art. It brings out a good approach to storytelling and to the selection of a story. It has great value in training courses for librarians and teachers. Eighteen stories are given in full. The revised edition includes a foreword by Anne Carroll Moore, and the bibliography has been brought up to date by Eulalie Steinmetz.

The Way of the Storyteller. By Ruth Sawyer. (Viking.) This book combines the philosophy and the rich experience of one of the best modern storytellers. It includes 11 stories as well as an excellent bibliography.

How to Tell Stories to Children. By Sara Cone Bryant. (Houghton.) A helpful book for teachers or mothers inexperienced in telling stories to little children. Now out of print, but available in many libraries.

Books of Stories

Twenty-Four Unusual Stories. Selected and edited by Anna Cogswell Tyler. (Harcourt.) Unusual stories especially suitable for older boys and girls.

Tales of Laughter. Selected by Kate Douglas Wiggin and Nora A. Smith. (Doubleday.) More than a hundred folk and fairy tales chosen for their humor and for their value as literature.

Granny's Wonderful Chair. By Frances Browne. (Macmillan.) Eight stories of fairyland told to a little girl by her grandmother's wonderful chair. 'The Christmas Cuckoo' and 'The Greedy Shepherd' are especially popular.

Big Music. Chosen by Mary Noel Bleecker. (Viking.) An excellent selection by an experienced storyteller of twenty humorous and vigorous folk tales.

A Baker's Dozen. Selected by Mary Gould Davis. (Harcourt.) Thirteen favorite stories of boys and girls with an introductory chapter for storytellers.

The Wonder Clock. By Howard Pyle. (Harper.) Twenty-four stories by a master storyteller and a fine artist. Text and pictures are inseparable.

The Long Christmas. By Ruth Sawyer. (Viking.) A collection of stories to celebrate the birth of the Christ Child. They come from Spain, Italy, Ireland, Austria, the Isle of Man, the gypsies, and France.

Puck of Pook's Hill. Rewards and Fairies. By Rudyard Kipling. (Doubleday.) A brilliant re-creation of the drama of English history for storytellers and children. In time they begin with pre-Christian days in 'Weland's Sword' and go on through the Roman occupation of Britain and Queen Elizabeth I's reign to the American Revolution in 'Brother Squaretoes'.

The Bold Dragoon and Other Ghostly Tales. By Washington Irving. Edited by Anne Carroll Moore. (Knopf.) A fine collection of classic American stories to tell at Halloween or around the campfire at night.

The Day's Work. By Rudyard Kipling. (Doubleday.) Good tales by the master storyteller to narrate to older boys and girls. Favorites among them are '007' and 'The Brushwood Boy'.

Rhymes and Verses. By Walter de La Mare. (Holt.) Story poems, like 'The Isle of Lone', please boys and girls who are sensitive to the sounds of words, while the shorter poems make a good beginning and ending of the story hour.

The Great Quillow. By James Thurber. (Harcourt.) A humorous fantasy that tells of a toymaker and a giant. The author's 'Many Moons' is equally good.

The Street of Little Shops. By Margery Williams Bianco. (Doubleday.) Gay and original stories of village life. 'The Baker's Daughter' is a great favorite with the children.

See also the bibliography *Following the Folk Tales Around the World* (in a later section of this article); and the bibliography on Christmas.

Following the Folk Tales Around the World

"In the mountains there lived a lion who was king of all that place." Drawing by Vladimir Lebedev from 'The Lion and the Ox', retold from 'The Panchatantra'. (Macmillan.)

FOLLOWING the path of the folk tales is a stimulating adventure. It takes us around the world in space and through the centuries in time. It has the same thrill that explorers must feel when they set out to find new lands. It brings knowledge, too, just as surely as knowledge came to the old discoverers when they charted unknown seas. It also brings an understanding of men's motives and a tolerance that recognizes faith where ignorance would see only superstition. It is especially necessary to have this knowledge now when modern science and invention has brought the world into a close community of nations. From all over the world there is a demand today for unity and understanding.

The old folk tales, told and retold by the human voice, for centuries before they were recorded, grow up out of the life of a country as a tree grows up out of its soil. As a tree is shaped by the sun and the wind, the heat and the cold, the drought and the rain, so the folk tales are shaped by the thoughts and the actions, the aspirations and the fears of a people. Often the outline of a story, and sometimes even the characters, are common to more than one country. But always the land itself and the people who dwell there leave a deep impression. It is as though they had dressed the story in their own native costume and made it their own.

It would be hard to find a better antidote for the passions and prejudices of our world than the folk tales. Their humor, their freshness, their clean objective action, their logical and clear-cut distinction between good and evil are as refreshing to us in our perplexing international problems as the shade of a green tree is refreshing to a traveler who has stumbled along for hours under a blazing sun. Children turn to them instinctively because of their clear construction. They set the scene, introduce the characters and go on at once to the action. Traditionally the action progresses in a cycle of three incidents, the third incident is the climax and is followed by the "and they lived happily ever after"—a phrase common to many tongues. The characters in folk tales are always sharply defined. One often hears children ask for a story under the name of the hero or heroine. It is through the affection and the memory of the children that Jack the Giant-Killer, Mollie Whuppie, Little Black Sambo, and others have been immortalized. In the East the folk tales are more subtle. In the West they are simpler and more objective.

The Far East

Some of the oldest fables and folk tales which have been handed down to us came from the cradle of civilization, the East. One of the best and widely known of the Hindu folk collections is the book translated from the Sanskrit called 'The Panchatantra'. In the translation of it by Arthur W. Ryder, prose into prose and verse into verse, it has something to say to everyone from the very wise to the very ignorant. It has the wisdom that appeals to age and the simplicity and humor that appeal to youth.

Chiefly from India come the stories that tell of the rebirth of the Buddha in the form of different animals. The best translation for storytellers, Marie L. Shedlock's 'Eastern Stories and Legends', is out of print. Miss Shedlock was too sensitive and too wise to point the moral of the tales. Yet, in each one the lesson that a great teacher sought to give his followers is evident. One detail of her wording is significant. Instead of beginning the story with the conventional "Once upon a time," she begins it with the words that the teachers use in the temples, "And it came to pass that the Buddha was born as a . . . ." This sometimes puzzles the children; but that perplexity is often the beginning of understanding. The best retellings of the Buddha stories for younger readers that are now in print are the two collections 'Jataka Tales Re-told' and 'More Jataka Tales Re-told' edited by Ellen C. Babbitt.

One of the best collections of the tales that the people of India tell one another is 'The Talking Thrush' by the English scholar W. H. D. Rouse. 'The Cat and the Parrot' is a great favorite. Older boys and girls like 'The Wise Old Shepherd'. Mabel Ashe Beling's 'The Wicked Goldsmith' contains one of the adventures of Rama, the epic hero of India.

It is fairly recently that the folk tales of China were put into form for American children. One of the most famous of them tells the adventures of the Stone Monkey. Arthur Waley has translated it, and the first seven chapters are in a book called 'The Adventures of Monkey' with illustrations by Kurt Wiese. The gifted young Chinese artist Plato Chan has made a part of the story into the picture book 'Magic Monkey'. It was originally written by Wu Ch'eng-en of the T'ang Dynasty. Recent additions to Chinese folk-lore are 'Folk Tales from China' and 'More Folk Tales from China' by Lim Sian-tek. They include legends and fairy tales and are illustrated with unusual line drawings by William Arthur Smith. Another collection is 'The Treasure of Li-Po', six original fairy tales of old China told by Alice Ritchie and illustrated by T. Ritchie. Before these were published, a French writer, now living in America, had told in both French and English an old Chinese folk tale called 'The Five Chinese Brothers'. Later, it was published with illustrations in color by Kurt Wiese. It has proved to be one of the most popular picture books presented to boys and girls for many years. A variant of it is in one of Lim Siantek's books.

Many of the translations of the Japanese folk tales are now out of print. A classic among them is Lafcadio Hearn's translation of 'The Boy Who Drew Cats'. What is needed is a new edition in one volume of the stories he translated, with attractive format and illustrations. American boys and girls would like to see a new printing of Madame Ozaki's 'Japanese Fairy Book'. They welcomed the new collection of old tales retold by Yoshiko Uchida, called 'The Dancing Kettle and Other Japanese Folk Tales'.

"He rubbed it, and the genie appeared saying, 'What is thy will?'" Drawing by Vera Bock from the 'Arabian Nights' by Andrew Lang. (Longmans.)

The Middle East

From Persia comes a cycle of stories as complete and as dramatic as any cycle in the literature of the world. It is a long narrative poem by a Persian poet, Firdausi, and is called 'The Shah Nameh'. It celebrates the Persian kings—Zal, Rustam, Kai Khosrau and others. The story of Zal and Rudabeh, the father and mother of Rustam, is a moving and beautiful love story. Boys especially like the scene when Zal is questioned by the Wise Men and the Mubids to test his wisdom as a potential ruler. Rustam is the hero of Matthew Arnold's poem 'Sohrab and Rustum'.

In Arabia the hero story is told in 'The Romance of Antar' by Eunice Tietjens. Antar was a great poet, a great warrior and a great lover. He sang as he rode into battle and his songs, surging up through the hoofbeats of the horses and the clash of arms, were remembered and recorded by his followers. An old chronicler once said of Antar: "He was like no other child born of the desert, like a fragment of a thunder cloud." The stories from the Arabian Nights Entertainment are too well known to need comment. One of the favorite translations was made in the 19th century by Andrew Lang. A new edition has been issued which has distinguished illustrations by Vera Bock.

From Turkey comes a group of amusing tales told by the gullible, good-natured Nasr-ed-Din, who was known as 'The Hodja'. His stories were collected and translated by Alice Geer Kelsey in a book called 'Once the Hodja'.

Russia

For the transition from East to West there is a group of tales from the Caucasus Mountains in Russia that were first recorded in lovely, singing verse by the greatest of Russian poets, Alexander Pushkin.

"Each morning the artist knelt quietly on a mat and painted beautiful little pictures." Drawing by Lynd Ward from 'The Cat Who Went to Heaven' by Elizabeth Coatsworth. (Macmillan.)

Even in the English translation the words are like music. They always carry a sense of the old Russia—cold winters and the passionate welcome of spring, great distances and spaces, and its dependence on animals. In Ida Zeitlin's poetic wording of the famous foreword to Pushkin's 'Skazki', we read:

> There is a halcyon sea, and from its untroubled waters silver mists rise.
>
> And a gnarled oak grows on the shore, and a learned cat that is chained with a chain of gold walks forward and back. And he sings as he goes to the right, and as he goes to the left he tells strange tales of enchantment.

These Russian stories tell of a people who love color and beauty of form, whose imagination personifies the natural elements and gives speech to animals. Post Wheeler has translated some of these Caucasus tales in his 'Russian Wonder Tales'. The 19th-century composers have made some of these stories immortal through their compositions.

A favorite Russian story is 'The Little Humpbacked Horse'. It is in Post Wheeler's book, and Titiana Drowne has translated it into English verse in 'The Little Magic Horse' with illustrations in color by Vera Bock. Then there are the simple, humorous tales of the Russian peasants, often with animals for characters. Arthur Ransome tells some of them in his 'Old Peter's Russian Tales', and Valery Carrick tells them for younger children in 'Picture Tales from the Russian'. He illustrates them with black and white drawings that children particularly like. There is one for every page. It is a good book to give children who are just learning to read; but boys and girls of almost any age like to chuckle over the Russian version of 'Gingerbread Boy'. It is called 'The Bun', and instead of the "sowers and reapers" the little bun meets a rabbit, a wolf, and a bear. Chanting his song, he gets away from them all, only to fall at last into the greedy mouth of the sly, red fox.

The most comprehensive collection of Russian folk stories ever published in English is the 'Russian Fairy Tales' translated by Norbert Guterman. It has unusual illustrations in color by Alexander Alexeieff. It is a selection from the famous collection of Afanasiev, and includes more than 170 folk tales. There is an informing commentary by Roman Jakobson. Altogether it is an invaluable source for storytellers.

Finland

Finland can boast of one of the greatest of the epic tales—the Kalevala. It is so ancient that no one knows when it was first sung. It was not until the 19th century, however, that Zacharias Topelius and Elias Lönnrot gathered it into a complete poem. Soon afterward it was translated into English blank verse by John Martin Crawford and published in America. Surely Henry Wadsworth Longfellow took the meter for his 'Hiawatha' from the Kalevala. Contrast the two lullabies:

> Yonder is thy golden infant,
> There thy holy babe lies sleeping,
> Hidden to his belt in water,
> Hidden in the reeds and rushes.

And from Longfellow's epic poem 'Hiawatha':

Drawing by Alexander Alexeieff from 'Russian Fairy Tales', translated by Norbert Guterman. (Pantheon Books.)

> There the wrinkled old Nokomis
> Nursed the little Hiawatha,
> Rocked him in his linden cradle
> Bedded soft in moss and rushes.

The heroes, Ilmarinen the Smith and Wainamoinen the Minstrel, are so individual, so full of courage and humor and vitality that they leave a deep impression. Their wooing of the Maid of Beauty makes modern love stories seem but "milk and water" by comparison. One of the best versions of the Kalevala in prose is Babette Deutsch's 'Heroes of the Kalevala'. Parker Fillmore translated the Finnish folk tales in 'Mighty Mikko'. Mikko is the Finnish fox, certainly a close relation of the French Reynard. The wolf is called Pekka and the kindly, stupid bear Osmo. The dialogue

between them is filled with humor. Evidently the Finnish peasant loves argument. The Finnish folk tales are great fun to tell. 'Tales from a Finnish Tupa' is an excellent collection. James Cloyd Bowman made the selection and did a literary translation from a literal translation into English by Aili Kolehmainen. Margery Bianco was the reviser.

Poland

Many of the folk tales and legends of Poland have been preserved by the Catholic Church. The people have a friendly, naive feeling for the great figures in the Christian religion, and this feeling is expressed in their folklore. Saint Joseph makes a plough to help a poor farmer. Saint Peter engages in a lively dialogue with a cobbler who wants to get into heaven. Saint Anna, the mother of the Virgin, hangs the heavenly household goods out to air and some mischievous little angels tear the cover of the down comforter—and so snow falls on earth.

These stories are translated by Lucia Borski and published in a beautifully designed book called 'Polish Folk Tales'. A second group of tales that have been told for centuries to the children of Poland is also translated by Mrs. Borski. They are in two volumes: 'The Jolly Tailor' and 'The Gypsy and the Bear'. Children particularly like 'The Jolly Tailor'—a story that has all the biting wit and the cryptic phrasing characteristic of the native Polish storyteller.

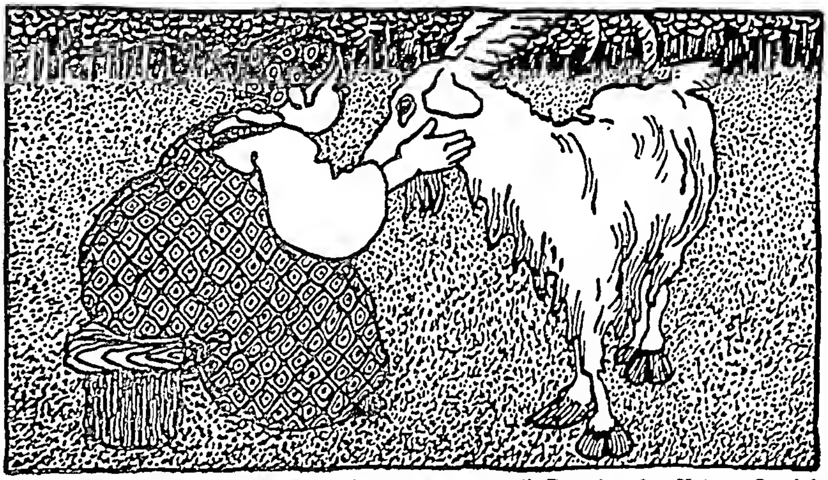
A charming legend of the little cat who sang a lullaby for the Christ Child has been made into a picture book with unusual and beautiful drawings in color by a Polish artist, Irena Lorentowicz. She illustrates, too, the story of 'The Nine Cry-Baby Dolls'—an amusing old folk tale that has in it a kernel of wisdom. It is evident from all the translations that the Polish people love to tell a good story and to bring to it their wit and their skill in dialogue.

Czechoslovakia

The Czechs, for all their stormy history, have preserved a folk art and folk literature that is a constant and ever-living tribute to them. The picture book called 'The Cock and the Hen' is a fine example of the color and beauty of their folk art. It is illustrated by Rudolf Mates. The translation by Raf Szalatnay published in this country is out of print. Parker Fillmore has translated the lively, humorous Czech folk tales in several volumes. Little children especially like three stories in a book called 'The Shoemaker's Apron'—Kuřátko, Budulínek and Smolíček. Kuřátko follows the pattern of a story from northern India called 'The Cat and the Parrot'. Both are very popular in the story hour, where boys and girls love to chuckle over the adventures of the greedy, boastful Indian cat and the Czech rooster. In Parker Fillmore's 'Czechoslovak Fairy Tales' there is a tale called Katcha and the Devil. It has a variant in Spain and is a good choice for older boys and girls and even for adults. The Czech devil is a stupid, gullible creature. This account of how a determined old woman outwitted him is spicy and amusing.

Germany

From Germany come folk tales that are known all over the civilized world. They were taken down from all sorts of people, rich and poor, high and low, by two brothers—Wilhelm and Jakob Grimm—in the 19th century. It is great fun to trace the variants of these stories. Here is the Anglo-Saxon 'Tom Tit Tot' as 'Rumpelstiltskin.' Here is the French 'Sleeping Beauty' as 'Briar Rose'. Here is the Finnish tale, 'The Partners' as 'The Cat and the Mouse Keep House'. Here is the English droll, 'The Three Sillies' as 'Clever Elsie'. And there are many others. Even a story from the Middle East called 'Hafiz the Stone-Cutter' is here as 'The Fisherman and His Wife'. How did these stories travel? What wandering pilgrim or storyteller brought them into Central Europe? They have been translated and illustrated in many English editions. One of the most successful is Wanda Gág's. A famous artist before she began to work on the German folk tales as both translator and illustrator, she has given them freshness and zest and an irresistible humor. The first translation into English of the *complete* collection of the Brothers Grimm was made by Norbert Guterman and published by Pantheon Books. It has a foreword by Padraic Colum and is illustrated by Josef Scharl (*see* Grimm).



"There was an old woman who had a gray goat." Drawing by Valery Carrick from 'Still More Russian Picture Tales', a companion book to 'Picture Tales from the Russian'. (Lippincott.)

Germany's hero story is common to Germany, Norway, and Iceland—the story of Siegfried. In German it is called 'The Nibelungenlied' and is the foundation story for Richard Wagner's opera cycle, 'The Ring'. The form in which this hero story is told is clearer and more objective in Norway.

The Scandinavian Countries

In Norway the story of Siegfried is called 'The Volsunga Saga'. It follows the old pattern of the epic tales. A hero must be born to rid the world of evil. He must forge his own sword. He must find a horse

that will carry him unharmed through fire and water. Then his mission begins. There is a dignity, a splendor about the Volsunga Saga that gives it a high place in the folk literature of the world. William Morris

"He said . . . 'Mother, what is the matter? Are you angry with me?'" Drawing by Dorothy Lake Gregory from the story 'Dwarf Long Nose' in the collection 'The Violet Fairy Book' by Andrew Lang. (Longmans.)

translated it into English calling it 'The Volsunga Saga', working with Eirikr Magnusson. Then he wrote a prose version—'The Story of Sigurd the Volsung'. Dorothy Hosford's 'Sons of the Volsungs' tells the story for boys and girls.

The Norse folk tales are vigorous, humorous, and a delight to tell. They are filled with the spirit of their country. To hear Gudrun Thorne-Thomsen tell them is almost as good as a trip to Norway. In them is a sense of the pine forests and rocky hillsides, the prosperous farm lands and wide meadows, the white birches, the dark sea water cutting the narrow fiords. In them we meet the fearsome trolls and Boots, the younger son who manages to win the princess. White bears wander among the trees, and the heroine follows her lover east of the sun and west of the moon. They are grand tales to tell at Christmas because they suggest the scent of pine and spruce, a log fire roaring up the chimney, and the snow lying thick and white on roof and hillside. Collected in the 19th century by Asbjornsen and Moe, they were almost immediately translated into English by Sir George Dasent. His work on them is of a very high order. The first edition of his translation, 'Popular Tales from the North', contains a foreword which is an invaluable comment on the path of the folk tales. Warmed with his enthusiasm and informed with a thorough scholarship, it is an inspiration to all lovers of folklore. Sigrid Undset's translation is called 'True and Untrue'. Edgar Parin d'Aulaire and his wife Ingri, a Norwegian, have portrayed in picture books the life of Norway for younger boys and girls. The first impressions of native Norwegian customs and traditions have come to many very young Americans through 'Ola' and 'Ola and Blakken'.

Very little is in print now of the folklore of Sweden. Luckily Selma Lagerlof's 'The Wonderful Adventures of Nils' is available. It is creative writing, not folklore, although some of the native legends are woven into it. One is the story of Glimminge Castle and the epic war between the Black Rats and the Gray Rats. Another is a legend found also in Brittany of a city that lies under the sea. The sound of its church bells can be heard on Easter morning. The story of Nils' flight on the back of the wise goose is so representative of Sweden that the tale has become a sort of folk-history of Sweden for American children. The stories are included in an edition with drawings by Baumhauer.

In Denmark there is a group of folk tales that were first translated into English by J. C. Bay. They have been retold by Mary C. Hatch in 'Thirteen Danish Tales' and 'More Danish Tales'. Children especially like the story 'The Talking Pot'. Denmark's unique distinction lies, however, in the fact that Hans Christian Andersen is one of its sons. Although he tells some of the folk tales of Denmark, he stamps them with his own peculiar genius. His creative writing, the "wonder tales", are read and told and read again all over the civilized world. Many scholars have translated them into English, and many famous artists have illustrated them. The first four fairy tales were published in Denmark in 1835. One hundred years later a centenary edition was issued by an American publisher with woodcut illustrations by Gwen Raverat. No tribute is too great to pay to the genius of Hans Christian Andersen. He left to the children of the world, and to their elders,

"And inside, what should he find but a big, white cat seated comfortably in a chair by the window." Drawing by Edgun from 'Thirteen Danish Tales' retold by Mary C. Hatch. (Harcourt.)

an imperishable legacy of beauty and humor. Even in translation Andersen's wit and homely philosophy delight his readers (*see* Andersen).

The British Isles

In the British Isles there are five separate folklores: Anglo-Saxon, the pixie stories in Cornwall, Welsh, Scottish, and Irish. The epic tale of the Anglo-Saxons is the story of Beowulf, the half mythical, half historical record of the warrior king. It is a stirring tale of the courage, resourcefulness, and integrity of a hero who was worshiped by his people. He typifies all that is best in the British race. It has been well told in prose by Dorothy Hosford in a book called 'By His Own Might'.

The Anglo-Saxon folk tales are too familiar to need much comment. Who can stand on Highgate Hill and not remember Dick Whittington and the Bow Bells? Who can resist or forget the courage and the humor of Molly Whuppie? The quaint tales the people call "drolls" are great favorites with children everywhere. They listen with delight to 'The Teeny Tiny Woman' and 'The Three Sillies' and 'Master of All Masters'—if the storyteller has enough breath to tell it to the very end. These stories and many more are in two books by Joseph Jacobs, 'English Fairy Tales' and 'More English Fairy Tales'. Down in Cornwall are the pixies—those impish, enchanting little creatures who may have been brought to England by the Phoenicians when they came to mine tin. Enys Tregarthen told their adventures with great humor and understanding. Elizabeth Yates went over her material and published some of her stories in a book called 'Piskey Folk'. Among them is the story of the fairy ointment and the strange, haunting tale of 'Skerry-Werry'.

The heroic Beowulf's pitched battle with the fearful dragon. Drawing by Laszlo Matulay from 'By His Own Might' by Dorothy Hosford. (Holt.)

The legends of King Arthur and his knights can be traced through Devonshire, Cornwall, and Wales. On a rocky promontory in north Devon are the ruins of Arthur's castle. Below it on the cliff is the cave where Merlin hid him as a baby. Standing here, looking north and west over the sea, we can see in imagination the ship that carried Tristram and Isolde from Ireland to King Mark—and tragedy. The famous cycle was first written by Sir Thomas Malory. It was printed by the Caxton Press in 1469. Howard Pyle's genius as both author and artist best presents it for boys and girls. In Marie Shedlock's 'The Art of the Storyteller' there is a curious legend, retold from ancient Welsh sources, of the awakening of King Arthur and his knights from their long sleep in a cave on a Welsh hillside. It is an Englishman who wakens them, and he has come to the cave seeking gold. There is a challenge to young people in Arthur's response when he hears the sound of the bell:

"It is only a seeker after gold who has rung the bell. Sleep on, my warriors; the morn of Wales has not yet dawned."

Wales has its own epic tale, 'The Mabinogion', recorded probably before Sir Thomas Malory wrote the Arthur cycle. Sidney Lanier's version, 'Knightly Legends of Wales', is probably the best known. Another version is 'The Island of the Mighty' by Padraic Colum and it is illustrated by Wilfred Jones.

In the north, in Scotland, is the most nearly human of the "over the border" creatures—the Scottish Brownie. The tale of how he finally departed for the far hills after serving humans for centuries, is told by Frances Olcott in 'The Book of Elves and Fairies'. It was a Brownie, still friendly to humans, who came back to the village of Blednock to re-establish old relations. But the village people were afraid of him, so he returned sadly to the hills. In Scotland, too, is the old shepherd's tale of Habbetrot the Spinner. Beatrix Potter tells it in her 'Fairy Caravan'. One of the saddest of all love stories is the Scottish ballad tale, 'Binnorie'. It is told in prose by Joseph Jacobs. Then there is Robert Burns' 'Tam o' Shanter'. Anna Cogswell Tyler gives the storyteller's version of that in 'Twenty Four Unusual Stories'. Some of the Gaelic legends from the west highlands and legends of the saints who came early to the islands off the coast of Scotland are still to be told for boys and girls.

Over the sea in Ireland is that matchless cycle of the legendary kings called the Tuatha Dè Danann. Irish poets, dramatists, and storytellers have told and written these stories for centuries. They bring us down through Cormac and Finn MacCool to Cuchulain, who was called the Hound of Ulster, and to the coming of Saint Patrick. Perhaps the most

appealing of the hero-kings is Finn MacCool. Ella Young tells part of his story in her exquisite prose 'The Tangle-Coated Horse'. One of the most beautiful passages in Celtic literature is the Fairy Woman's prophecy about Cuchulain, when Queen Maeve boasts of her rule of all Ireland. Standing before the Queen at twilight in the open fields the Fairy Woman says:

> Through all my dreams there comes a lad. Young though he is the marks of many wounds are on his skin, and round his head there shines the hero's light. A face he has the noblest and the best, and in his eyes sparkles the champion's gleam A stripling, fair and honest in his home, but in the battle fierce and tough and strong as though he wore a mighty dragon's form
>
> By him your hosts are all hewn down. And on the battlefield the slain, foot laid to foot and hand to hand, do lie. Before the hosts of Ulster all unmoved he stands as if to guard them from the fight.
>
> To all the world this youth's name shall be known—Cuchulain, son of Sualtach of the Feats. But in the North, because he guards their homes as a good watchdog guards the flocks upon the mountain side, men call him lovingly—the Hound of Ulster.

It is Ella Young who tells the story of Balor's son and of Angus the poet, and the mischievous, ever-changing Pooka. Her story 'The Wonder-Smith and His Son' is the tale of the Gubbaun Saor, the Master-Builder, and his daughter Aunya. Like so many Irish writers of the past and present, Ella Young is a poet. Her prose is like music. There are many versions, oral and written of the Celtic legend of the Children of Lir who were condemned by a wicked stepmother to float as swans on the lakes of Ireland for nine hundred years, but hers is the most beautiful. The words of this tale are music—the faint, eerie music of the swan's song.

"The Son of the Gubbaun got to his feet. 'I *could travel* the world', he said, 'with my reed-flute and the Hound that came to me out of the Wood of Gold and Silver Yew Trees'." Drawing by Boris Artzybasheff from 'The Wonder-Smith and His Son' by Ella Young. (Longmans.)

The peasant tales of Ireland, the stories that are told around the peat fire by a wandering storyteller, are best retold by Seumas MacManus. In them is the Irish wit, the exaggeration, the love of adventure. All of them are more effective when they are told than when they are read. They need to be shared, and boys and girls everywhere love to listen to them. How they do chuckle over the story of 'Billy Beg and His Bull'. Ruth Sawyer brought some of these tales of the Irish "seanachies" back from Ireland with her. Some are in her 'The Way of the Storyteller' and the favorite one, 'The Voyage of the Wee Red Cap', is in 'The Long Christmas'.

Greece

In Greece are the animal fables, first recorded by the Greek slave, Aesop, and the myths—those splendid tales of gods and men in the springtime of the world. Joseph Jacobs has selected and edited the fables in a book with illustrations by Richard Heighway. Another fascinating edition is the one arranged by Boris Artzybasheff from the Croxall edition of 1722 and the James edition of 1848. His illustrations are woodcut engravings, original and spiced with humor. It is a book for every age, not especially for children. The 'Iliad' and the 'Odyssey', Homer's magnificent epics of war and adventure, have been told in prose, in one volume, by Padraic Colum. A more recent translation of the 'Odyssey' and one that has a modern touch is by the English scholar W. H. D. Rouse. It has a special appeal for older boys and girls. The most complete record of the Greek legends and myths and the two great epic poems was written in German by Gustav Benjamin Schwab. It has been translated into English by Olga Marx and Ernst Morwitz in a book called 'Gods and Heroes'. The introduction by Werner Jaeger is an invaluable guide to the literature of Greece.

Italy

Across the Adriatic from Greece lies Italy. No one who knows Italy and the Italians can doubt their possession of a rich and rewarding folklore. Their native ability to tell a story and to tell it dramatically is as much a part of them as their flexible and expressive hands. The most commonplace incident becomes a miniature drama when it is told by an Italian to an Italian.

Their hero story is their own version of 'The Song of Roland'. It was written by a poet, Ludovico Ariosto, and published in Tuscany in 1516. 'Orlando Furioso', as it is called, is in 64 cantos. It glorifies the Christian knights who defended the tomb of Christ against the Saracens during the Crusades. The saga is played today in its entirety by the almost life-size Sicilian puppets.

In the 17th century Giambattista Basile collected the Romance language folk and fairy tales in a volume

called 'The Pentamerone'. He wrote it in a Neapolitan dialect that was afterward discarded. It lay "on the shelf" for a number of years. Then the Italian poet and philosopher, Benedetto Croce, with the help of other scholars, wrote the tales in modern Italian. They were almost immediately translated into English by N. M. Penzer. This book is an intensely human document, interesting not only to lovers of folklore, but to everyone who follows the social development of a race. Shrewd, naive, humorous, these stories reveal more of the true Italy than volumes of formal history.

Up in Umbria and Tuscany Luigi Capuana collected the folk tales in two very popular books called 'C'era una volta' and 'Fiabe'. Dorothy Emmrich translated them into English, and they have been read and told in America under the titles 'Italian Fairy Tales' and 'Golden-Feather'. They are so characteristic of the Italian peasant in the northern provinces that to tell or listen to them is to hear him speak. Here are his humor, his shrewdness, his love for the land, his quick temper and jealousy and his quicker recovery. As one watches the Tuscan peasants cultivating their little "piani" on the slopes of the Apennines one feels that the old stories still lie buried in the minds of the people. They tell them to one another, but they have not yet recorded them for the world to hear and read. Some day there will be a revival of the old art of the storyteller in Italy, and the editors and artists will vie with one another to bring the stories into book form. This is indicated in a recent book by an Italian author and artist, Dino Buzzati. This is not a folk tale but it is deeply Italian in thought and feeling. It is called 'The Bears' Famous Invasion of Sicily', and the illustrations in color are as dramatic and expressive as the story.

France

France is so rich in her traditional literature and so happy in its recording that one longs to spend a lifetime studying it. To France belongs the most appealing, the most radiantly alive of all the hero stories—the Song of Roland. It was first sung by Taillefer, the troubadour of William, Duke of Normandy, in the 11th century. Henry Adams tells the story in his 'Mont Saint Michel and Chartres'. To Taillefer's hearers Roland was a living memory, the nephew of Charlemagne, and a Frenchman who had died for France. His qualities—youth, courage, pride, impulsiveness—are inherent in the Song and especially so in a translation by Charles Scott-Moncrieff made just after the first World War. Traveling from Mont Saint Michel where, as Henry Adams says, the Song is "most at home," to the high pass of the Gave River where the battle of Roncesvalles was fought one gets a vivid impression of the story. Here above the green plain of Provence, with snow-capped mountains on the sky line, are the beech trees guarding the upland meadow where Roland laid the bodies of Archbishop

"The hare, from too great a feeling of security, and too much confidence in victory, overslept . . . and arrived . . . only to see that the tortoise had got in before her." Wood engraving by Boris Artzybasheff from 'Aesop's Fables'. (Viking.)

Turpin and of Oliver "with their faces turned toward France." Here is where he tried to break his sword, Durendal, and—failing, hung it in the branches overhead. As one stands here the words of the Song repeat themselves in his mind. Henry Adams says that the song of Roland was "chanted by every minstrel, known by heart, from beginning to end, by every man, woman, and child, lay or clerical, translated into every tongue, more intensely felt—if possible—in Italy and Spain than in Normandy and England, perhaps most effective as a work of art when sung by the Templars in their great castles in the Holy Land." A prose version for boys and girls by James Baldwin gives not only the Song, but also earlier incidents in Roland's life that were sung by the troubadours in the Middle Ages.

To France, too, belongs the story of Reynard the Fox. This appeared in a collection of tales called The Beast Saga, written in Latin in the twelfth century. It has lived as a satire and is always a source of fun. Never was there such a villain—bird, beast, or man—as Reynard. He was everything that one should not be, but where else can one find so attractive a sinner? The trial scene is one of the wittiest bits of prose that French literature has produced. Its wit and its cleverness have become, as it were, a part of the French inheritance. Reynard's story is best read in French in

the edition with the illustrations by A. Vimar. There is, however, an excellent translation into English by André Norton, with illustrations in black and white by Laura Bannon, one of which is shown below.

Even more popular around the world are the French fairy tales, first told by Charles Perrault to the ladies and gentlemen of the court of Louis XIV and later written as a book for the children of France. Sir George Dasent says of them: "Among the French tales we have passed from the woods and fields and hills to my lady's boudoir." The mark that the witty French lawyer and scholar left on them can never be effaced. The only translation into English that holds his charm and beauty of wording is in Walter De La Mare's 'Told Again'. In his words the story of Cinderella becomes an exquisite love story set in a medieval city at Christmas time. Madame la Comtesse d' Aulnoy followed Perrault, telling her delicate, romantic stories in England as well as in France. Perrault's stories were illustrated by Gustave Doré, as well as by numerous other famous artists. The Doré edition is called 'All the French Fairy Tales'.

"And then he said to my wife that if she wished fish, she needs must sit above the hole with her tail in the water." Drawing by Laura Bannon from 'Rogue Reynard' by André Norton. (Houghton.)

Spain

Spain has a great treasure of folklore, not only of her own but from countries that were settled in the New World by her people. Some day the Spanish archives will be opened and the stories told for boys and girls. Until fairly recently there was very little from Spain for children. Ruth Sawyer tells a group of the tales that have been preserved among the peasants and goatherds in a book, 'Picture Tales from Spain'. Among them is a story of one of the adventures of the royal mouse, Perez. The adventure that American children know best is the one that came through Puerto Rico with Pura Belpré in her 'Perez and Martina', with enchanting illustrations in color by Carlos Sanchez. Another favorite character among the children of Spain is Padre Porko. The history of this generous, kindly pig, who advised, doctored, and helped birds, animals, and even humans, is translated into English by Robert Davis with drawings by Fritz Eichenberg.

A group of folk tales, many of them from southern Spain, was translated by Ralph Boggs and retold by Mary Gould Davis. It is called 'Three Golden Oranges'. All of the work on this collection was done "on the spot," each story written and illustrated by Emma Brock in the place where it was first recorded. Washington Irving's 'The Alhambra' is the invaluable record of the legends connected with the exquisite palace and courtyards of the Moorish kings near Granada. It is sheer good luck that one of the great American writers should have worded the tales of the Alhambra—that place where the sound of running water makes constant music and the lovely ivory curves and arches rise against a sky that seems forever blue.

The Spanish hero story is half history, half legend. Rodrigo de Bivar lived in the 11th century and fought to save Spain from the Moors. He is known everywhere as "The Cid." His story, called 'El Cantar de Mio Cid', was translated into English by Robert Southey and became as popular in England as in Spain. The best version for boys and girls is Merriam Sherwood's 'The Tale of the Warrior Lord'.

Latin America

It is through Spain that we come finally to the New World. The Spanish explorers and missionaries, coming to South America and Mexico and the southwestern part of North America, brought with them their faith, their language, and their folklore. They found among the native Indians an older culture and a literature that has only recently been written for children. Some of the old tales may be found in a book called 'Stories from the Americas', compiled by Frank Henius and illustrated by Leo Politi. Anita Brenner gathered the Mexican folk tales in the book 'The Boy Who Could Do Anything', illustrated by Jean Charlot. She heard some of them told by an old woman at Milpa Alta The boy's name was Tepozton and he is half god, half man.

In Brazil the native carnival has been described for children in 'Maria Rosa', a book written by Vera Kelsey with pictures in color by a distinguished Brazilian artist, Candido Portinari. Charles Finger's 'Tales from Silver Lands' are from the Indians of Brazil. Since the publication of the book in 1924 they have been told and widely read all over the United States. These stories are well worth study by anyone who is interested in folklore. 'The Tale of the Lazy People' is the origin story of monkeys. There is a curious wisdom in it that makes the mysterious old man who carves the little figures out of wood the forerunner of the modern psychiatrist. Through his study of the people he knew what they needed better than they knew themselves. The story, 'The Cat and the Dream Man' has a theme as old as the human race—the power of suggestion through the sub-conscious, through dreams. The evil that is projected from the cat while she sleeps is conquered by the courage and skill of a boy who outwits the cat in a race and so destroys the power of her dreams. Maud Hart and Delos Wheeler Lovelace have recorded some of the legends of the Indians of South America in a book called 'The Golden Wedge'. They are the "creation" stories in which the gods are brought to earth to help man establish his civilization. An amusing tale from the Indians of Brazil is translated by Maria Cimino and illustrated by Luis Jardim. It is called 'The Armadillo and the Monkey'. The folklore of South and Central America and of Mexico offers a challenge to writers and artists of tomorrow.

The wooing of the little cockroach, Martina, by Perez, the royal mouse. Drawing by Carlos Sanchez from 'Perez and Martina' by Pura Belpré. (Warne.)

North America

In North America there is today a heartening revival of interest in our native folklore. It has been strengthened by writers like Carl Sandburg, Stephen Vincent Benét, and Carl Carmer. John and Alan Lomax added greatly to its vitality by going about the country gathering ballads and work songs from the people. They recorded them for the Folklore Division of The Library of Congress, and published them in a book called 'Folk Song, U.S.A.'. Carl Carmer's 'America Sings' gives a selection of the legends and "tall tales" with the basic song and its music. Anne Malcolmson collected some of them in a book that boys and girls like—'Yankee Doodle's Cousins'—with vigorous and amusing drawings by Robert McCloskey. In the Great Smoky Mountains native storytellers have been telling for many years the adventures of a boy named Jack, many of them founded on the European folk tales. They are in a book called 'The Jack Tales', recorded in the local idiom by Richard Chase. One of the finest examples of a tall tale about a great American is Stephen Vincent Benét's 'The Devil and Daniel Webster'. The trial scene when Daniel calls on the spirits of America's dead to come back and testify is one of the jewels in our literary inheritance. In a second story called 'Daniel Webster and the Sea Serpent', Benét tells of the sea serpent, Samanthy, who follows Daniel to Washington and haunts the Potomac River, much to Daniel's embarrassment. With his wife, Rosemary Benét, he wrote, too, a group of poems called 'A Book of Americans'. These create a vivid impression of our national heroes. We hear that:

Peregrine White and
Virginia Dare
Were the first real
Americans anywhere.

"The Padre came to Spain with the Irish, hundreds of years before the Romans and the Arabs and such quarrelsome people." Drawing by Fritz Eichenberg from 'Padre Porko' by Robert Davis. (Holiday House.)

Then we are carried from P. T. Barnum to Woodrow Wilson. Carl Sandburg's 'Rootabaga Stories' are not really folk tales because he was the first to tell them. A thousand years from now they will

probably be told and remembered for their glorification of the simple, homely things that are so vital a part of American life. Only a great poet could have written so truly and so beautifully.

Indians of North America

Legends and folk tales of the American Indians have been retold by outstanding writers and anthropologists. One by one these fine collections have gone out of print. It is to be hoped that librarians, teachers, storytellers, and booksellers will work together to develop a greater interest in Indian folklore. If a great demand for these tales develops, publishers will gladly bring the best of the older collections back in print and will publish new collections.

Frank Hamilton Cushing spent years gathering the stories of the Zuñi Indians, and his book remains their finest record. George Bird Grinnell's collection of the Blackfoot stories includes one of the most important of all Indian legends—the 'Legend of Scarface.' Scarface was the first "pioneer" to cross the Great Divide and see the shining expanse of the Pacific Ocean. In his journey we can see, as in a prophecy, the long procession of fur traders and pioneers who peopled the West. It is a story that stirs the blood of American boys and girls. From the Indian tribes in Canada comes the hero story of Raven, the god who stole fire from heaven to warm the earth. This story is told in 'Old Raven's World' by Jean Maury and in 'The Box of Daylight' by W. H. Hillyer. These last two collections are out of print. Among the books available is 'In My Mother's House', a picture book from the Pueblos. The drawings are by an Indian artist, Velino Herrera. The Eskimo folk tales are told with humor by Charles Gillham in a book called 'Beyond the Clapping Mountains'.

"De panter say, 'I'se mad 'cause you brought everybody sumpn 'cept me!'" Drawing by Fritz Eichenberg from 'Big Road Walker' by Eula Duncan. (Lippincott.)

American Tall Tales

In the last two or three decades the American tall tales have been given fine treatment by American writers and collectors. All of the stories of the famous lumberman, Paul Bunyan, and Babe the Blue Ox have been collected in one volume by Harold Felton. There is a good deal of controversy over the origin of Paul and Babe. This book gives the testimony from both spoken and written sources. Esther Shephard's version, with illustrations by Rockwell Kent, is one of the most popular. Louis Untermeyer tells most of the adventures in a rhythmic prose that makes his book a good source for storytellers.

The tale of Pecos Bill, the greatest cowboy of them all, is recorded in a book by James Cloyd Bowman. Bill's exciting career has an irresistible appeal to young people. It is great fun to share with them Bill's invention of the Perpetual Motion Ranch, his taming of the mustang, Widow Maker, and his wooing of Slue-foot Sue. It is Bowman, too, who tells the story of John Henry, the Negro hero who "beat the steam-drill."

The Negro folk tales have been told supremely well by Joel Chandler Harris in his 'Uncle Remus'. Luckily, the perfect illustrator was at hand when the books were published. No artist will ever characterize in pictures Brer Fox and Brer Rabbit and Brer Tarrypin with greater clarity and humor than A. B. Frost did in the original editions. From a Negro cook in North Carolina comes a group of stories about a legendary hero called Big Road Walker and his tiny wife, Hokey. They were recorded in their original idiom by Eula Duncan, and illustrated with great success by Fritz Eichenberg.

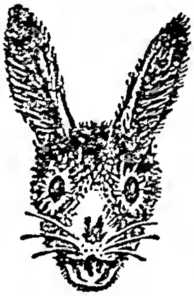
In all the American folk tales one feels strongly those qualities that make America. Humor is in them, and courage and faith and initiative. The American love of "tall talk" is there, her boastfulness, her desire to "show off." And behind them all is the rugged splendor of the land itself; the beauty of virgin forests, of wide, fertile fields, of rushing rivers and snow-capped mountains. American inventiveness today dominates land and sky, but the spirit that inspired it is inherent in her folk tales. They are worth preserving because they express a people made up of many races but looking toward the unity of thought and purpose that was defined by the makers of our Constitution when the United States of America was born.

Africa

Africa, with its many tribal languages, its overlay of culture brought by the many countries that

have colonized it, has been slow in presenting its native folklore to the world. In 1921 there was published in France a collection of African folklore that was made by the French writer Blaise Cendrars. It is called 'Anthologie Nègre', and some of the stories in it were translated into English by Margery Bianco. These stories are fascinating, dramatic, and primitive and a great contribution to folk literature. Albert Helser translated some of the Nigerian folk tales in his 'African Stories'. This book is for students of folklore rather than for children. Both the boys and girls and the storytellers liked Erick Berry's 'Black Folk Tales' as long as it was available.

In 1945 E. B. Kalibala brought to America a group of stories from the Buganda tribe of East Africa. It was published a year or so later in a book for the children called 'Wakaima and the Clay Man'. These may be the origin stories of Uncle Remus. The title story is almost certainly 'The Tar Baby', and Wakaima is Brer Rabbit in an older setting. The outstanding book of African folklore for children and adults is 'The Cow-Tail Switch' by Harold Courlander and George Herzog. The stories are from West Africa; they have the strength, humor, and rhythm that reflects centuries of telling. In many of them, as in most very old folk tales, a moral lesson is implied. Mr. Courlander collaborated with Wolf Leslau in recording and retelling the folk tales of Ethiopia in a book called 'The Fire on the Mountain'.



"Mr. Hare." (Wakaima.)

In South Africa Pattie Price collected some of the tales of the Zulu tribes in a book called 'Bantu Tales'. She tells these tales in a rhythmic free verse that reflects the manner of the originals. The favorite story, as far as American boys and girls are concerned, is the tale of Nya-nga the serpent. It is a convincing picture of children in an African village. Undoubtedly more of the African folklore will be brought into form, translated, edited, and illustrated for publication.

Modern communication and recording has opened up the folk art and folk literature of the most remote people. Physically the world has been explored and mapped. But the stored up riches of mind and spirit are not available yet to everyone—everywhere. The path of the folk tales is defined, but many treasures along its way are still hidden. To bring them to light for the children of the world is a challenging adventure.

"Mr. Hare took a sharp knife and, very carefully, he shaved off the hind end." Drawings by Avery Johnson from 'Wakaima and the Clay Man' by E. B. Kalibala and M. G. Davis. (Longmans.)

A List of Folk Tales from Many Lands

The Far East

The Panchatantra. Translated from the Sanskrit by Arthur W. Ryder. (University of Chicago Press.) These stories form one of the oldest, wisest, and wittiest of books. In this translation they are understood even by little children.

Jataka Tales Re-told. More Jataka Tales Re-told. By Ellen C. Babbitt. (Appleton.) Simple retellings of the Buddha stories from the oldest folklore extant.

The Five Brothers; the Story of the Mahabharata. Adapted from the English translation of Kisari Mohan Ganguli by Elizabeth Seeger. Illustrated by Cyrus LeRoy Baldridge. (Day.) A version of the famous Hindu epic for young people.

Kantchil's Lime Pit. By Harold Courlander. Illustrated by Robert W. Kane. (Harcourt.) Living folk tales from Indonesia gathered from original sources.

The Dancing Kettle and Other Japanese Folk Tales. Retold by Yoshiko Uchida. (Harcourt.) Fourteen authentic stories which had been told to the author in her childhood.

Bhimsa the Dancing Bear. By Christine Weston. (Scribner.) A fantasy, based upon reality, that is outstanding for its atmosphere and the quality of its prose.

Japanese Fairy Tales. By Lafcadio Hearn. (Liveright.) Not all the stories in this collection are translated by Lafcadio Hearn, but it does include one of the best and most characteristic of the Japanese folk tales, 'The Boy Who Drew Cats'.

The Cat Who Went to Heaven. By Elizabeth Coatsworth. Illustrated by Lynd Ward. (Macmillan.) A Japanese legend which is told in poetic prose and has distinguished illustrations.

Folk Tales from China. More Folk Tales from China. Compiled by Lim Sian-tek. With illustrations by William Arthur Smith. (Day.) Legends and folk tales told by a Chinese who has known them since childhood. The illustrations reflect perfectly their spirit and tradition.

The Adventures of Monkey. Adapted from the translation made from the Chinese of Wu Ch'eng-en by Arthur Waley. (Day.) A story that "has delighted millions of Chinese children and adults for over three hundred years." This translation is illustrated by Kurt Wiese.

The Good-Luck Horse. By Chih-yi and Plato Chan. (Whittlesey.) A Chinese legend of a boy and his miraculous

pony, Good-Luck Horse, told with many pictures by an artist and his sister.

The Magic Monkey. By Plato and Christina Chan. (Whittlesey.) A version for younger children of the classic Chinese hero tale.

The Treasure of Li-Po. By Alice Ritchie. Illustrated by T. Ritchie. (Harcourt.) Six original Chinese fairy tales told in traditional style by an English writer.

Shen of the Sea. By A. B. Chrisman. (Dutton.) Folk tales of China that tell the origin of tea, of chopsticks, of dragons, etc.

The Five Chinese Brothers. By Claire Huchet Bishop. Illustrated by Kurt Wiese. (Coward-McCann.) A Chinese folk tale told with great skill and illustrated with pictures.

Once in the First Times. Compiled and edited by Elizabeth Hough Sechrist. Illustrated by John Sheppard. (Macrae.) Legends and folk tales from the Philippine Islands, with the tribe indicated from which each story came. Includes myths of the first Filipinos.

The Middle East

The Arabian Nights. Edited by Andrew Lang. Revised edition with illustrations by Vera Bock and a foreword by Mary Gould Davis. (Longmans.)

The Arabian Nights. Edited by Kate Douglas Wiggin and Nora A. Smith. (Scribner.) Illustrated with twelve full-page pictures in color by Maxfield Parrish.

Once the Hodja. By Alice Geer Kelsey. (Longmans.) Stories told in Turkey five centuries ago by Nasr-ed-Din. "Children of Turkey know and laugh at them today."

Russia

Russian Fairy Tales. Translation by Norbert Guterman. Illustrations by Alexander Alexeieff. (Pantheon, o.p.) The most comprehensive collection of Russian folklore in English, with an invaluable commentary by Roman Jakobson and unusual illustrations by Alexander Alexeieff.

Russian Wonder Tales. By Post Wheeler. (The Beechhurst Press.) The dramatic, colorful folk tales of the Caucasus retold by a scholar who has kept their beauty and their rhythm. The illustrations in color are by Bilibin.

Yes and No Stories. By George and Helen W. Papashvily. (Harper.) A book of Georgian folk tales.

Tales of Faraway Folk. By Babette Deutsch and Avrahm Yarmolinsky. (Harper.) The peasant source of these little-known stories from the lands of the Baltic and the White seas is reflected in the illustrations by Irena Lorentowicz.

Finland

Heroes of the Kalevala. By Babette Deutsch. (Messner.) An excellent retelling in prose of the Kalevala. It includes the story of Lemminkainen as well as the forging of the Sampo and the wooing of the Maid of Beauty.

Tales from a Finnish Tupa. By James Cloyd Bowman and Margery Bianco. From a translation by Aili Kolehmainen. (Whitman.) The folk tales of Finland in an excellent translation. They are gay and funny and dramatic. Children love to listen to them.

Mighty Mikko. By Parker Fillmore. (Harcourt, o. p.) The folk tales of Finland told with vigor and humor. The title story, a favorite with boys and girls, is also in 'A Baker's Dozen' by Mary Gould Davis. (Harcourt.)

Poland

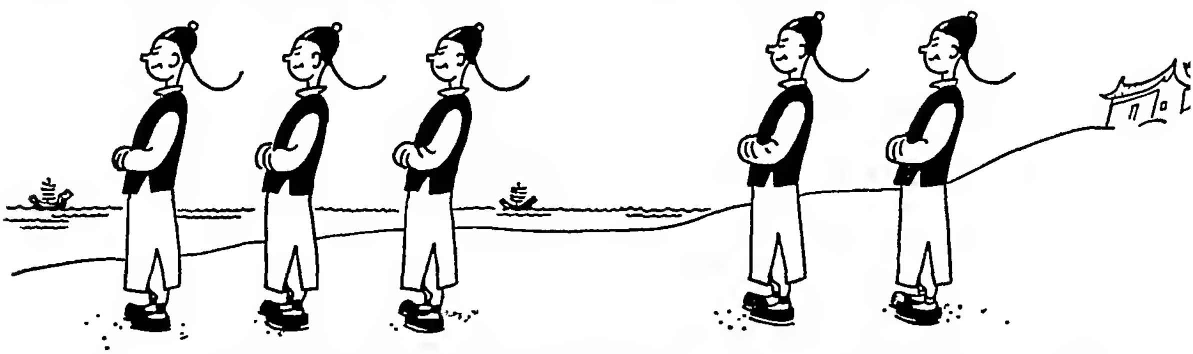
Polish Folk Tales. Translated by Lucia Merecka Borski. Illustrated by Erica Gorecka-Egan. (Sheed.) Legends that have been preserved by the Catholic Church in Poland and folk tales that have been "remembered" by the people.

The Jolly Tailor. Translated by Lucia Merecka Borski and Kate B. Miller. (Longmans.) A collection of Polish folk tales, cryptic and amusing. The favorite story with the children is the title story about Mr. Joseph Nitechka "who was a very thin man and had a small beard of one hundred and thirty-six hairs."

Czechoslovakia

The Shoemaker's Apron. By Parker Fillmore. (Harcourt.) In this collection are the three most popular stories for little children: 'Budulínek', 'Smolíček', and 'Kuřátko'.

The Laughing Prince. By Parker Fillmore. (Harcourt.) Another collection of the Czech folk tales. It includes the story of 'The Girl in the Chest'.



"Once upon a time there were five Chinese brothers and they all looked exactly alike." Drawing by Kurt Wiese from 'The Five Chinese Brothers' by Claire Huchet Bishop. (Coward-McCann.)

The Little Magic Horse. Translated by Titania Drowne. Illustrated by Vera Bock. (Macmillan.) A well-known folk tale translated into English verse with fascinating illustrations in color. The prose version is in the Post Wheeler translation.

Old Peter's Russian Tales. By Arthur Ransome. (Nelson.) An attractive edition of the authentic tales of old Russia.

Picture Tales from the Russian. By Valery Carrick. (Lippincott.) Younger children enjoy listening to these simple amusing tales of the Russian peasants. There are many pictures.

To Your Good Health. In 'The Art of the Storyteller' by Marie Shedlock. (Dover.) A good-humored Russian folk tale for the beginning storyteller that never fails to hold an audience. It is great fun to read aloud as well as to tell.

Czechoslovak Fairy Tales. By Parker Fillmore. (Harcourt.) Almost all boys and girls like these Czech folk tales. They are very old, very true to Czech peasant life, and full of fun.

Germany

Tales from Grimm. More Tales from Grimm. Freely translated and illustrated by Wanda Gág. (Coward-McCann.) This is the edition for the children because of the illustrations, and for the storytellers because of the wording. The text has the rhythmic quality of stories that have been told for centuries. Equally valuable is Wanda Gág's 'Gone Is Gone' and 'Snow White and the Seven Dwarfs'.

Household Stories by the Brothers Grimm. (Macmillan.) This edition, with illustrations by Walter Crane, is the one that every family should have.

Grimm's Fairy Tales; complete edition. (Pantheon.) The only complete record in English of the German folk tales gathered by the Brothers Grimm. This is illustrated with more than two hundred drawings, many in color, by the distinguished artist, Josef Scharl. For anyone interested in storytelling and in folklore it is a necessary book.

Scandinavian Countries

Swords of the Vikings. By Julia Davis Adams. (Dutton.) Stories of the Norse heroes retold from Saxo Grammaticus. For the older boys and girls.

Thunder of the Gods. By Dorothy Hosford. Illustrated by Claire and George Louden. (Holt.) Vigorous retellings of the Norse myths from the Icelandic Prose Edda.

East o' the Sun and West o' the Moon. Edited by Gudrun Thorne-Thomsen. (Row.) Twenty-five of the vigorous, dramatic Norse folk tales retold by a famous storyteller.

True and Untrue. Edited and compiled by Sigrid Undset. (Knopf.) The famous novelist's own choice of her native folk tales. There are black and white illustrations by Frederick Chapman.

The Hen That Saved the World. By Margaret Sperry. Illustrated by Per Beckman. (Day.) Fresh interpretations of the traditional Asbjornsen and Moe stories.

Ola. Ola and Blakken. By Ingri and Edgar Parin d'Aulaire. (Doubleday.) Two picture books in color that tell of a little boy in Norway, his three sisters Line, Sine, and Trine, a fierce trollcock, and the gentle horse Blakken.

Thirteen Danish Tales. More Danish Tales. Retold by Mary C. Hatch. (Harcourt.) A new translation of the cryptic, amusing folk tales of Denmark. The first book includes the ever-popular story called 'The Talking Pot'.

The Wonderful Adventures of Nils. By Selma Lagerlöf. (Pantheon.) These are folk tales only in the sense that the Swedish novelist has woven the native legends into the story. In this edition both adventures are included in the one volume with illustrations by H. Baumhauer and an endpaper map of Nils's journey.

Fairy Tales. By Hans Christian Andersen. Illustrated by Elizabeth MacKinstry. With an introduction by Anne Carroll Moore. (Coward-McCann.) There are many editions and translations of the stories of this great creative writer. This edition is especially valuable for its selection, its illustrations, and its foreword.

The British Isles

By His Own Might; The Battles of Beowulf. By Dorothy Hosford. (Holt.) A fine translation of the Anglo-Saxon epic poem with unusual illustrations by Laszlo Matulay.

English Fairy Tales. More English Fairy Tales. Edited by Joseph Jacobs. (Putnam.) These two books contain the best and most familiar of Anglo-Saxon folk tales. Children like them because here they find stories like 'Dick Whittington', 'Jack the Giant-Killer', 'Mollie Whuppie'.

Told Again. By Walter de la Mare. (Knopf.) English and European folk tales touched by the magic of a poet's pen. 'The Hare and the Hedgehog' is the perfect story for a spring story hour; 'Cinderella', as Walter de la Mare tells it, is for the Christmas festival.

The Story of King Arthur and His Knights. Written and illustrated by Howard Pyle. (Scribner.) It would be difficult to find a finer presentation of a hero story than in this and the two companion volumes. In both text and illustration they measure up to their theme.

The Boys' King Arthur; Sir Thomas Malory's History. Edited by Sidney Lanier. (Scribner.) This retelling of the old record by an American poet is illustrated by N. C. Wyeth.

Arthur in the Cave. In 'The Art of the Storyteller' by Marie L. Shedlock. (Dover.) The wondrously strange and ancient Welsh legend of the awakening of King Arthur and his knights from their long sleep in a Welsh cave.

The Merry Adventures of Robin Hood. By Howard Pyle. (Scribner.) Possibly the best of all versions of Robin Hood, by the noted children's author and illustrator, was reissued to celebrate the hundredth birthday anniversary of the publishing house of Charles Scribner's Sons.

The Sons o' Cormac. By Aldis Dunbar. (Dutton.) Hero stories, told with distinction, from the Celtic 'Tuatha Dè Danann'.

The Tangle-Coated Horse. By Ella Young. (Longmans.) Part of the Fionn Saga beautifully told with distinguished illustrations by Vera Bock.

The Wonder-Smith and His Son. By Ella Young. (Longmans.) The tale of the Gubbaun Saor, the wonder-smith of the 'Tuatha Dè Danann', told in rhythmic prose with illustrations by Boris Artzybasheff.

The Boy Who Knew What the Birds Said. By Padraic Colum. (Macmillan.) Eight quaintly told stories which are based on Irish tales. They are delightfully full of traditional Irish humor and imagination.

The Unicorn with Silver Shoes. By Ella Young. (Longmans.) The tale of the son of Balor, King of Fairyland, the Pooka, and Flame of Joy told by a Celtic poet with illustrations by Robert Lawson.

Irish Fairy Tales. By James Stephens. (Macmillan.) A favorite version of the traditional Celtic tales by an Irish poet and novelist.

Well o' the World's End. By Seumas MacManus. (Devin-Adair.) A collection of folk tales told by a master storyteller, a Shanachy from Donegal.

Celtic Fairy Tales. Edited by Joseph Jacobs. (Putnam.) A companion volume to 'English Fairy Tales', this tells simply the outstanding folk tales of Ireland.

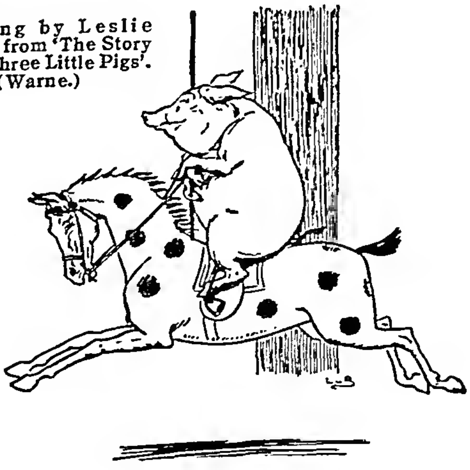
The Big Tree of Bunlahy; Stories of My Own Countryside. By Padraic Colum. (Macmillan, o.p.) A fine collection of stories that includes two of the Cormac tales and a typical Irish folk tale called 'Our Hen'.

Jack O'Moora, and the King of Ireland's Son. By Bryan MacMahon. Illustrated by Richard Bennett. (Dutton.) A completely Irish story that has rhythm and cadence, a repetitive pattern, and mystical overtones.

Wee Meg Barnileg and the Fairies. In 'The Way of the Storyteller' by Ruth Sawyer. (Viking.) There are three other Irish tales in this book which is dedicated to the author's childhood nurse, Johanna of County Donegal.

The Wind in the Willows. By Kenneth Grahame. Illustrated by E. H. Shepard. (Scribner.) This story of Rarty, Mole, and Mr. Toad is universal in its appeal. The 'Dulce Domun' chapter is especially for Christmas, and 'The Piper at the Gates of Dawn', for spring.

Drawing by Leslie Brooke from 'The Story of the Three Little Pigs'. (Warne.)



Dick Whittington and His Cat. By Marcia Brown. (Scribner.) Illustrated by the author. A fascinating retelling of the famous story of the poor orphan who became mayor of London and the cat who brought him fortune.

The Wizard and His Magic Powder. By Alfred S. Campbell. Illustrated by Kurt Wiese. (Knopf.) These are native tales of the Channel Islands which are half-English and half-French in origin but unlike folk tales of either country.

The Golden Goose Book. By Leslie Brooke. (Warne.) Four familiar folk tales illustrated by an artist who under-

stood children and gave of his genius to make their stories rich in atmosphere, beauty, and humor.

Greece

Fables of Aesop. Edited by Joseph Jacobs. (Macmillan.) An excellent edition with drawings by Richard Heighway.

"A long time ago there was a little boy and his name was Tepozton." Drawing by Jean Charlot from 'The Boy Who Could Do Anything' by Anita Brenner. (William R. Scott.)

Aesop's Fables. Edited and illustrated by Boris Artzybasheff. (Viking.) Distinguished and highly original woodcuts illustrate an arrangement of the Croxall edition of 1722 and the James translation of 1848.

The Adventures of Odysseus and the Tale of Troy. By Padraic Colum. (Macmillan.) The two great epic poems told in prose. Excellent for background even if another version is selected for the telling.

The Iliad of Homer. The Odyssey of Homer. By Alfred J. Church. (Macmillan.)

Gods and Heroes. By Gustav Schwab. (Pantheon.) The famous collection of the legends, myths, and epic tales of Greece by a German scholar. An invaluable book, this is its first translation into English.

The Golden Fleece and the Heroes Who Lived Before Achilles. By Padraic Colum. (Macmillan.) Illustrated by Willy Pogany. Includes 'Voyage to Colchis', 'Return to Greece', 'Heroes of the Quest'.

The Heroes. By Charles Kingsley. (Macmillan.) The Greek heroes in a retelling that will never grow old.

The Wonder Book and Tanglewood Tales. By Nathaniel Hawthorne. (Dodd.) Hawthorne's two volumes of Greek myths bound in one. Illustrated by Maxfield Parrish.

Italy

The Pentamerone. By Giambattista Basile. Translated from the Italian of Benedetto Croce . . . by N. M. Penser. 2 volumes. (Dutton.) An 18th-century collection of the folk tales of southern Europe translated into modern Italian under the direction of a poet and scholar. An invaluable source for the study of the romantic folk tales.

Italian Fairy Tales. Golden Feather. Translated from the Italian of Luigi Capuana by Dorothy Emmrich. (Dutton, o.p.) Folk tales of Tuscany and Umbria in an excellent translation that preserves their vitality and humor.

The Seven Miracles of Gubbio. By Raymond Bruckberger. (Harper.) An allegory from 'The Little Flowers of St. Francis of Assisi' that has been translated from a French source by Gerold Lauck with sensitivity and real beauty.

The Bears' Famous Invasion of Sicily. Written and illustrated by Dino Buzzati. (Pantheon.) An amusing and delightfully written story to tell or to read aloud, with equally enchanting pictures in full color.

France

Song of Roland. Translated by Charles Scott-Moncrieff. (Dutton.) This English blank verse translation has the same quality of youth and courage found in the original song sung by Taillefer at Mont Saint Michel in the 11th century.

The Story of Roland. By James Baldwin. (Scribner.) A retelling in prose of the great epic song that includes the stories of Roland's childhood, gleaned from the songs and tales of the Middle Ages.

Mont Saint Michel and Chartres. By Henry Adams. (Houghton.) In this book Henry Adams tells the story of the first singing of the Song of Roland by Taillefer, the minstrel of the Duke of Normandy.

> "Taillefer who was famed for song,
> Mounted on a charger strong,
> Rode on before the Duke, and sang
> Of Roland and of Charlemagne,
> Oliver and vassals all
> Who fell in fight at Roncesvals."
> —Wace

Rogue Reynard. By André Norton. (Houghton.) A new and excellent translation of the Beast Saga with fine illustrations by Laura Bannon.

The Blue Fairy Book. Edited by Andrew Lang. With a foreword by Mary Gould Davis. (Longmans.) Fourteen of the thirty-three classic folk tales in this collection are from French sources: Charles Perrault, Madame d'Aulnoy, *Cabinet des Fées.*

Puss in Boots. By Marcia Brown. (Scribner.) A free translation from the French of Charles Perrault's beloved fairy tale with sweeping drawings in color on every page.

All the French Fairy Tales. By Charles Perrault. Illustrated by Gustave Doré. (Didier.) Five of the most famous of the French fairy tales. Foreword by Louis Untermeyer.

Stone Soup. By Marcia Brown. (Scribner.) An old folk tale told with humor in the setting of a French village in the days of Napoleon. It has many illustrations.

Spain

Picture Tales from Spain. By Ruth Sawyer. Illustrated by Carlos Sanchez. (Lippincott.) Native folk tales told by a skillful storyteller who preserves their humor and vitality.

Perez and Martina. By Pura Belpré. Illustrated by Carlos Sanchez. (Warne.) Originally from Spain, this romantic story of the wooing of Martina, the cockroach, by Perez, the royal mouse, is from Puerto Rico. Told in rhythmic prose, it is popular with all ages.

Padre Porko. By Robert Davis. Illustrated by Fritz Eichenberg. (Holiday.) One of the most beloved characters in the folklore of southern Europe is the kindly and humorous "gentlemanly pig" of Spain. This is a revised edition of his adventures with several new stories and more of Fritz Eichenberg's enchanting drawings.

Three Golden Oranges. By Ralph S. Boggs and Mary Gould Davis. Illustrated by Emma Brock. (Longmans.) The folk tales of Spain as they were recorded, written, and illustrated in their places of origin.

The Alhambra. By Washington Irving. (Macmillan.) One of America's greatest writers tells the legends of the Alhambra at Granada in southern Spain.

The Tale of the Warrior Lord. Translated from 'El Cantar de Mio Cid' by Merriam Sherwood. (Longmans.) The hero story, half legend, half history, of ancient Spain.

Latin America

Stories from the Americas. Edited by Frank Henius. Illustrated by Leo Politi. (Scribner.) Twenty stories from Mexico and Central and South America.

The Boy Who Could Do Anything. By Anita Brenner. (William R. Scott.) The traditional stories of the Indians of Mexico. It is illustrated by Jean Charlot.

A Hero by Mistake. By Anita Brenner. Illustrated by Jean Charlot. (William R. Scott.) There is humor and wisdom in this story of a Mexican Indian who was afraid.

Tales from Silver Lands. By Charles Finger. Illustrated with woodcuts by Paul Honoré. (Doubleday.) Folk tales of the Indians of Brazil, dramatic and colorful and quite different from the European and Eastern folk tales.

The Golden Wedge. By Maud Hart and Delos Wheeler Lovelace. (Crowell.) The early creation myths and legends of the South American Indians.

The Armadillo and the Monkey. By Luis Jardim. Translated by Maria Cimino. (Coward-McCann.) An amusing Brazilian folk tale witb many pictures by a Brazilian artist.

North America

Blackfoot Lodge Tales. By George Bird Grinnell. (Scribner.) These are the stories that foreshadow the discovery and settlement of North America. They include the best of the Indian hero stories, among them 'Scarface'.

Winter-Telling Stories. By Alice Lee Marriott. Illustrated by Roland Whitehorse. (Crowell.) Stories the Kiowa Indians tell about Saynday, who was a great joker.

Winabojo, Master of Life. By James Cloyd Bowman. Illustrated by Armstrong Sperry. (Whitman.) Indian myths and folk tales centered about the hero, Winabojo.

Thunder in the Mountains. By Hilda Mary Hooke. Illustrated by Clare Bice. (Oxford.) Legends of the Canadian Indians and tales by white men of witches, saints, etc.

The Talking Cat and Other Stories. By Natalie Savage Carlson. Pictures by Roger Duvoisin. (Harper.) French-Canadian tales that sparkle witb the Gallic wit and the *joie de vivre* of the *courier du bois* storyteller.

America Sings. Collected and told by Carl Carmer. (Knopf.) The folk tales and songs of America witb their music and many illustrations in color.

Yankee Doodle's Cousins. By Anne Malcolmson. (Houghton.) American "tall tales," very well told with unusual illustrations by Robert McCloskey.

The Jack Tales. Collected and edited by Richard Chase. Illustrated by Berkeley Williams, Jr. (Houghton.) Folk tales of the Southern mountains as tbey are told today by native storytellers. Jack is always the hero and his adventures may be traced back to the European folk tales. These have a definite rhythm and idiom found nowhere else in the world.

The New England Bean-Pot. By M. A. Jagendorf. (Vanguard.) A collection of folk tales from New England.

A Book of Americans. By Rosemary and Stephen Vincent Benét. (Rinehart.) Stories of famous Americans, from Virginia Dare to P. T. Barnum, told in verse.

The Devil and Daniel Webster. By Stepben Vincent Benét. (Rinehart.) A story that brings out the humor and the power of a great American. The trial scene when the ghosts of America's famous villains act as jurors is a challenge to the art of storytelling.

Daniel Webster and the Sea Serpent. By Stephen Vincent Benét. In 'Strange and Fantastic Stories', edited by J. A. Margolies. (McGraw.) In which the lady sea serpent Samanthy falls in love with Webster and follows him to Washington.

Rootabaga Stories. By Carl Sandburg. (Harcourt.) American fairy tales that for their beauty, truth, and humor may well become the classic American folk tales.

In My Mother's House. By Ann Nolan Clark. Illustrated by Velino Herrera. (Viking.) A beautiful picture book of the Pueblo Indians. Illustrations by an Indian artist.

Beyond the Clapping Mountains. By Charles E. Gillham. (Macmillan.) Folk tales of the Eskimos.

Legends of Paul Bunyan. Compiled and edited by Harold W. Felton. (Knopf.) All the Paul Bunyan tales, collected from varied sources. An invaluable record for storytellers.

Paul Bunyan. By Esther Shephard. Illustrated by Rockwell Kent. (Harcourt.) Paul's story as told in the Northwest.

Pecos Bill. By James Cloyd Bowman. Illustrated by Laura Bannon. (Whitman.) The full story of "the greatest cowboy of all time." It is a typical American tall tale.

John Henry. By James Cloyd Bowman. (Whitman.) The saga of the American Negro hero who "beat the steam drill." It has been told and told again until it bas become a part of our native folklore.

The Favorite Uncle Remus. By Joel Chandler Harris. Illustrated by A. B. Frost. (Houghton.) This collection includes stories from seven of the Uncle Remus volumes.

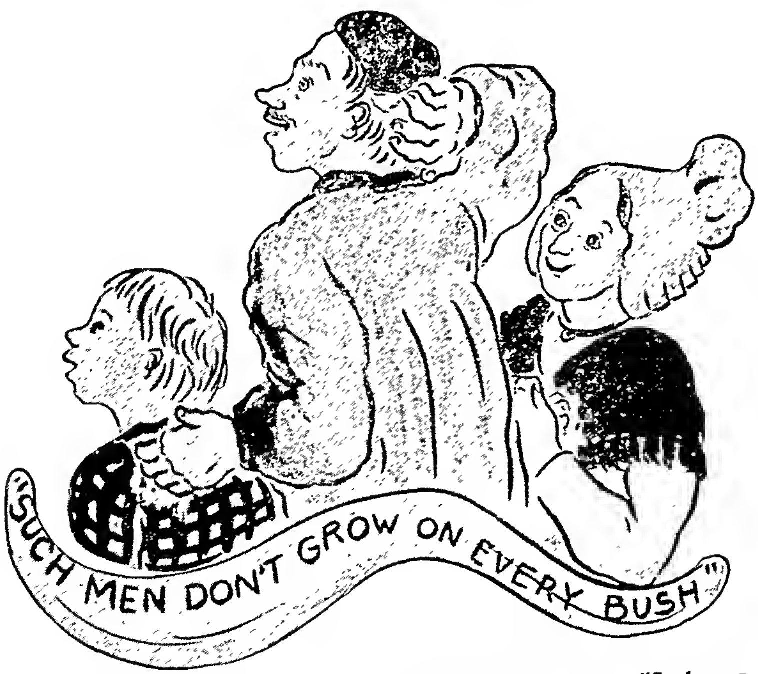
Big Road Walker. By Eula G. Duncan. Illustrated by Fritz Eichenberg. (Lippincott.) Big Road Walker and his tiny wife, Hokey, are folk heroes of North Carolina. The stories were told by a Negro woman in her own dialect.

Africa

The Fire on the Mountain and Other Ethiopian Stories. By Harold Courlander and Wolf Leslau. (Holt.) Folk tales of Ethiopia.

The Cow-Tail Switch. By Harold Courlander and George Herzog. Drawings by Madye Lee Chastain. (Holt.) Folk tales of West Africa. They have both wit and wisdom and are told witb skill and spirit.

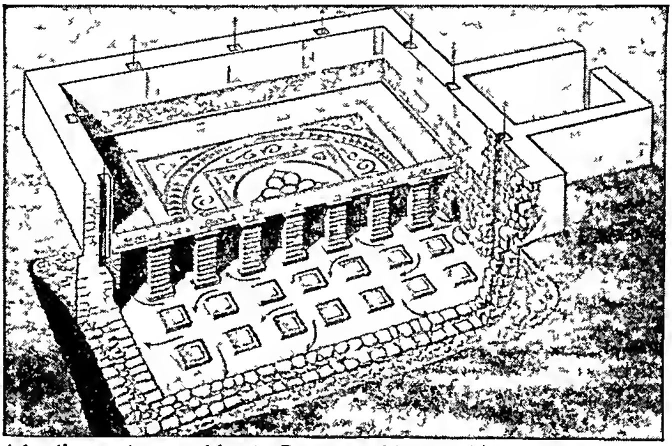
Wakaima and the Clay Man. By E. B. Kalibala and M. G. Davis. Illustrated by Avery Jobnson. (Longmans.) The Baganda folk tales of East Africa. They were probably tbe origin tales of Uncle Remus.



In a little town in France three soldiers teach the villagers how to make stone soup. "Such men don't grow on every bush," say the villagers as they watch the soldiers march away. Drawing by Marcia Brown from 'Stone Soup'. (Scribner.)

Stoves and Fireplaces. Portable heaters, ranging from simple braziers to cylinder-like structures partly enclosed by metal bands, were known in ancient Egypt and Greece, but were not developed into the fixed and entirely closed stove till comparatively modern times. Rich Romans warmed their homes by underground furnaces called *hypocausts;* but most Roman houses were unheated except for braziers. North of the Mediterranean, both rich and poor used open fires built on the floor. The smoke escaped through an opening in the roof or through open doors and windows. After the invention of the chimney in the 12th century, fireplaces with flues were built.

HOW THE ROMAN WARMED HIS HOME



A heating system used by the Romans is illustrated in this cross-section of a Roman house. Warm air issued from the furnace or stoke-hole at the right, and, after circulating between the numerous pillars of the ground floor, passed up through flues in the walls. The heated floor and walls kept the living-room warm.

Closed stoves appeared in Holland, Germany, and other countries of northern Europe at the end of the Middle Ages. These were great high structures of brick and porcelain tile with a small firebox at the bottom and a series of winding passages through which the heated smoke was conveyed. Stoves of this kind are still used in northern Europe. The bricks retain heat for hours, and a small quantity of wood, coal, or briquettes of coal dust will keep a room warm.

Fireplaces served the early colonists of America for both heating and cooking. Bake ovens of brick were often built into the fireplace. A fire was made in the oven, then raked out, and the bread or meat put in to be baked by the heat of the bricks.

Benjamin Franklin contributed to the development of the modern stove. In the 1740's, he invented a portable fireplace of iron that could be set out in the room, and so yield far more heat than a chimney fireplace. A modification of this iron fireplace, fitted with sliding doors, came to be known as the "Franklin stove." Further improvement on Franklin's device resulted in the box cooking-stove, with its oven below and pot-holes on top. Coal or wood stoves of this type are still commonly used in farm homes and in many of the smaller towns of the United States. The base-burning magazine stove, used for heating only, is also an outgrowth of Franklin's iron fireplace.

Stoves are more efficient than fireplaces; they deliver from 30 to 70 per cent of the heat value of the fuel against 10 to 20 per cent for fireplaces. Since most of the air warmed by a fireplace escapes up the chimney, its heating effect in a room comes chiefly from the action of the heat rays from glowing coals or flames on the walls and furniture. Fireplaces thus warm mainly by *radiation,* stoves mainly by *convection* (*see* Heat).

In cities of the United States stoves and fireplaces have been largely superseded by gas and electric ranges for cooking and by central heating systems using pipes to distribute hot air, hot water, or steam for warming (*See* Heating and Ventilating.)

Stowe, Harriet Beecher (1811-1896). No book has had a more direct and powerful influence on American history than Mrs. Stowe's 'Uncle Tom's Cabin'. By its vivid descriptions of suffering and oppression, this novel inflamed the people of the North against slavery, and thus became a force in bringing about the Civil War.

Mrs. Stowe, who was born at Litchfield, Conn., belonged to the famous Beecher family. Dr. Lyman Beecher, her father, and Henry Ward Beecher, her brother, were renowned preachers. And it has been said that Mrs. Stowe, too, was first of all a preacher, and only secondarily a novelist.

In 1832 the Beechers moved to Cincinnati, Ohio. Just across the Ohio River lay slave territory. Visits to plantations quickened Harriet Beecher's hatred of slavery. Her husband, Calvin E. Stowe, a professor at Lane Theological Seminary whom she married in 1836, was also strongly hostile to slavery; and together they helped many fugitive slaves escape to safety.

Soon after moving to Brunswick, Me., in 1850, Mrs. Stowe was challenged by her sister-in-law, Mrs. Edward Beecher, to "write something that would make this whole nation feel what an accursed thing slavery is!" The answer to that challenge was 'Uncle Tom's Cabin; or, Life Among the Lowly', which appeared serially in *The National Era,* an anti-slavery paper of Washington, D. C., in 1851. It was published in book form in 1852. Though the story depicted some of the kindly and patriarchal aspects of slavery, it emphasized the dark and cruel side.

The book was hastily written, yet its drama and emotional ardor gave it a wide appeal. It has been translated into more than 20 languages, and presented countless times on the stage and in motion pictures Its chief character, Uncle Tom, was modeled on a slave named Josiah Henson who in 1828 escaped into Canada and became a Methodist preacher.

Among Mrs. Stowe's other works are: 'The Mayflower' (1843), a collection of tales and sketches, 'Dred A Tale of the Dismal Swamp' (1856); 'The Minister's Wooing' (1859).

STRADIVARI, ANTONIO (1644–1737). The name Stradivarius on a violin means that it is one of the finest in the world. Antonio Stradivari made more than a thousand instruments, but only about 600 of his almost priceless violins remain. A few are owned and played by famed concert violinists, but most of them are treasures in museums and private collections (*see* Violin).

Antonio Stradivari was born in 1644 in Cremona, a village in northern Italy. When he was about 12 years old, he was apprenticed to Nicolo Amati, a famous Cremona violinmaker. Antonio learned quickly. He completed his apprenticeship in his early twenties and began labeling his violins with his own name. His signature always appeared in Latin. He used the spelling "Stradiuarius" until 1730, then changed it to "Stradivarius." He also made violas and cellos.

Stradivari (or Stradivarius) was married twice. Of his 11 children two sons, Francesco and Obomono, worked with him to make violins. Stradivari continued to work in Amati's shop until the older master died in 1684. Then he opened his own business on the ground floor of his house.

Early violins made by Stradivari were similar in design to Amati's. But about 1690 Stradivari began to increase the length and breadth of his instruments. The new size gave the violins a stronger tone. He also darkened the varnish on the instruments from a yellow to a rich amber. About 1700 Stradivari returned to his earlier 14-inch model. His violins of this period are marked by low arches, gentle curves, and close-set sound holes. They have full, rich, resonant tones that have never been surpassed.

Stradivari worked until his death at 93. So sure was his craftsmanship that the violins he made in his last year were almost equal to his finest. For the times, Stradivari received a good price for his work, about $50 or $75 for a violin. But the value of a fine Stradivarius has soared enormously. Today the value may reach more than $100,000. Many of his violins were given names by later owners. Among the most famous are the "Alard," the "Paganini," and the "Sarasate." The "Piatti" was his most famous cello.

STRATFORD-ON-AVON, ENGLAND. Probably no town in the world lives so completely on the memory of one famous man as the English town of Stratford on the Avon River, the home of the great poet Shakespeare. Each year Stratford is visited by thousands of tourists, many of them American.

In this ancient Warwickshire town, 93 miles northwest of London, Shakespeare was born, and here he died. Both he and Anne Hathaway, his wife, lie buried in the Church of the Holy Trinity. On the slab over his grave is the famous inscription, said to have been selected by Shakespeare himself:

> Good friend, for Jesus' sake forbeare
> To digg the dust encloased heare;
> Bleste be ye man that spares thes stones,
> and curst be he that moves my bones.

The house of Shakespeare's parents, which contains the small whitewashed room in which he was born, is still preserved. (For picture, *see* Shakespeare.) On the walls of this room appear innumerable signatures of distinguished visitors, among them the names of Walter Scott, Thackeray, and Dickens. The house serves in part as a museum of Shakespearean relics. The little thatched cottage in which Anne Hathaway was born at Shottery, about a mile from Stratford, is also a museum. At Wilmcote, near by, is the cottage of Shakespeare's mother, Mary Arden. In Stratford is a Shakespeare Memorial building, including a theater, an art gallery, and a library of his books. The theater, burned in 1926, was rebuilt by international subscriptions. Harvard House, owned by Harvard University, was the home of the mother of John Harvard, the university's founder. American visitors have given the Holy Trinity Church a stained glass window commemorating Shakespeare's poetry, and to the town a memorial fountain and clock tower.

Stratford lacks industry and today is pleasant and peaceful, with wide streets and quaint half-timbered houses, just as it was in Shakespeare's day. Population (1951 census, preliminary), 14,980.

STRATHCONA, LORD (1820–1914). "The grand old man of Canada," as he was called in his later years, was born in a little stone cottage in the town of Forres, Scotland. He was christened Donald Alexander Smith. The story of how he rose from poverty to wealth and fame is a true romance of pioneer Canada. He helped to transform a wilderness into a sturdy and fruitful country. He envisioned a united nation and helped to create it by connecting the Atlantic and Pacific seaboards with the Canadian Pacific Railway. His vision and his work largely brought about the development of western Canada. Through his remarkable achievements he became Sir Donald A. Smith and then Baron Strathcona and Mount Royal.

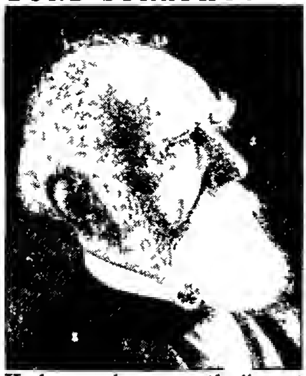
Before he was quite 18, this sturdy Scotch lad left his simple home to seek his fortune in the New World. He entered the service of the Hudson's Bay Company, which at that time controlled most of what is now Canada. For 13 years he roughed it in the dreary wilds of Labrador and was the first to prove that potatoes and other vegetables would grow on that bleak coast. Then he spent ten years more in the Canadian Northwest. He mastered the fur trade, he found time to read and study, and promotion followed promotion until he became the resident governor of the company, with headquarters in Montreal.

Fur traders, Indians, and half-breeds all respected and trusted Donald Smith. So when the rebellion under Louis Riel broke out on the Red River of the North in 1869, the Canadian government appointed him special commissioner to deal with the rebels, and to his tact was largely due the bloodless suppression of the uprising. When in 1870 the province of Manitoba was organized, he was elected to its first legislative assembly, and for many years he was a member of the Canadian House of Commons.

Donald Smith was a man of understanding and vision. He realized that if Canada was to become a great country, if the distant parts of this vast territory

were to be linked to the center, it must have a transcontinental railroad. It was largely through his financial and administrative ability, and the use of his own fortune, that the Canadian Pacific Railway was completed in 1885.

LORD STRATHCONA



He became known as the "grand old man of Canada."

Of the vast wealth which came to him from this railroad and other sources, he gave millions to McGill University, to Victoria College for Women at Montreal, to Royal Victoria Hospital, and to many other institutions. His most unusual gift, however, was made to the British government during the Boer War. At his own expense he equipped a regiment of cavalry known as Strathcona's Horse.

Donald Smith was knighted by Queen Victoria in 1886, and in 1897 he was made a baron with the titles Strathcona and Mount Royal. In 1896 he was appointed Canadian Lord High Commissioner in London. From that time until his death, in his 94th year, he was one of the most prominent figures in the British capital. Few men did more to strengthen the bonds between Canada and the British Empire.

STRAUSS (*shtrous*), **JOHANN, THE YOUNGER** (1825–1899). For nearly 100 years the Strauss family, father and sons, dominated the dance music of Europe. Johann Strauss the Elder (1804–1849) popularized the waltz. But it was his son, Johann the Younger, who won world fame as the "waltz king."

Johann Strauss the Younger was born in Vienna on Oct. 25, 1825. His father was popular throughout Europe as a conductor and composer. Johann wanted to be a musician and wrote his first waltz at the age of six. But the elder Strauss insisted that his sons follow other careers. Obediently Johann attended the Gymnasium and the Polytechnic Institute. After graduation he became a bank clerk. But meanwhile, encouraged by his mother, he secretly studied the violin and musical composition.

THE WALTZ KING

Johann Strauss the Younger composed nearly 400 waltzes.

When Johann was 17, his parents separated. He then devoted himself to music. Two years later he formed an orchestra. His first concert was a tremendous success. He played his own waltzes and one by his father. But the elder Strauss never became reconciled. A musical rivalry sprang up between them and lasted until the father's sudden death in 1849. Strauss then combined their orchestras and gave concerts throughout Germany. He later toured Europe and parts of the United States. He also served for 10 years as director of the St. Petersburg summer concerts. In 1862 Strauss married a popular singer, Henriette Treffz.

Besides 479 compositions, Strauss wrote 16 operettas (*see* Opera). Among his most famous waltzes were 'The Blue Danube', 'Tales from the Vienna Woods', 'The Emperor Waltz', and 'Wine, Women, and Song'. To find time to compose, Strauss transferred his orchestra to his younger brothers Joseph and Eduard. In 1878, following the death of his first wife, Strauss married another singer, Angelica Dittrich. He died June 3, 1899.

STRAUSS, RICHARD (1864–1949). The most talked of musician of the early 20th century was Richard Strauss, for in most of his compositions for orchestra he cared little for beautiful melodies, but rather tried to make his musical picture real. To do this he did not hesitate to employ the most discordant tone combinations, and to use the orchestra to produce extraordinary effects. Thus the hissing of steam is produced by rubbing a drumhead with brushes; the trampling of horses' feet by means of a wooden drum beaten with tubular sticks; rain is imitated with a drum filled with small stones.

RICHARD STRAUSS

He gained world fame both as a conductor and a composer.

Richard Strauss was born at Munich, Bavaria. His father was one of the greatest horn players of Germany and Richard early showed signs of musical talent. At four years he played the piano well, at six he was composing, and at ten he was seriously studying. Up to 1890 his compositions were not unusual, and he was known chiefly through his position as conductor of the Munich opera. From this time on, his compositions became distinctive for their radical innovations. Storms of criticism, ridicule, and abuse followed the appearance of each new work. But he won a place among the foremost composers and conductors of the day. In 1898 he settled in Berlin as conductor of the Royal Opera.

Of Strauss's operas, 'Salome' has probably been the most discussed, and his 'Rosenkavalier' the most liked. His symphonic poems have given rise to violent discussion, but his songs, with their melodic beauty and delicate charm, have been universally accepted.

STRAVINSKY, IGOR (born 1882). The early ballet music of Igor Stravinsky started a new musical trend of strange and complex tones. Yet Stravinsky later discarded it for the classical form.

Stravinsky was born at Oranienbaum, near present-day Leningrad, on June 17, 1882. His father was a

leading bass at the Imperial Opera. As a child Igor was given piano lessons, but the elder Stravinsky did not encourage the boy to make music his career. Igor entered the University of St. Petersburg to study law, but he continued to take private lessons.

When he was 19 years old, Stravinsky met Rimsky-Korsakov, the great Russian composer. At his suggestion, Stravinsky gave up law and devoted himself to composition. His first major work was a symphonic poem called 'Fireworks'. It attracted the attention of Sergei Diaghilev, director of the Ballet Russe in Paris. Diaghilev commissioned Stravinsky to write ballet music. For the ballet, he composed 'The Firebird', 'Petroushka', and 'The Rite of Spring'. These three brilliant scores were revolutionary in their tonal effect, and the critics violently condemned the young composer; but other musicians soon began to imitate him.

Following the first World War, Stravinsky's music became more austere. In 1923 he suddenly returned to classical forms. 'Oedipus Rex', 'The Symphony of Psalms', and 'Capriccio' were written during this period. Stravinsky made his home in the United States after 1941 and in 1945 he and his second wife became American citizens. His opera 'The Rake's Progress' had its world premiere in Venice in 1951.

STRAWBERRY. "Doubtless God could have made a better berry, but doubtless God never did." Izaak Walton paid this tribute to the strawberry in his book 'The Compleat Angler'. The wild berry, no larger than your finger tip, has a delicious flavor. So do the big cultivated berries. Every kind has a delightful odor. Altogether, strawberries deserve to be called "the rose among fruits." They are a good match for flowers in color and fragrance. (For illustrations in color, *see* Fruits.)

Growers have developed many varieties adapted to a wide range of climates and soils. Hence there is a crop somewhere in the United States every month in the year. The California season lasts through November. The next season starts in Florida in December. Thereafter every state in the Union has a crop at some time. The chief commercial producers are Louisiana, California, Arkansas, Oregon, Tennessee, Michigan, Florida, and North Carolina. From each center, shipments go under refrigeration to all the large markets in the country. People can have fresh berries from home gardens through a long season by planting both early and late varieties. They can also plant a "perpetual" or ever-bearing strawberry which bears fruit throughout the season. Quick-frozen fresh strawberries are sold all year long.

About 1,000 varieties of strawberries are grown in the United States today. It is surprising to learn that as late as the middle of the 19th century there were no strawberries in the city markets and few cultivated strawberry beds. Strawberries grow wild all through the North Temperate Zone and in the Andes region of South America, but little progress was made in their cultivation until a Chilean berry taken to England developed into a superior variety. Improved English varieties were later brought into the United States, but not until the Wilson berry appeared about 1840 was there a variety that could be depended upon for growth in every garden. Some of the earlier failures were due to the fact that certain kinds do not bear perfect fruit because their flowers do not produce sufficient pollen. Today varieties that are good pollen-bearers are always planted with such varieties to insure success.

A bed of strawberries is seldom kept in bearing more than a year or two. New plants may be obtained from seeds, which are always depended upon for developing new varieties, and from the division of the plant head. However, new plants are usually set from runners. These are placed in rows or hills on rich well-cultivated ground. After cultivation is discontinued, and usually after the bearing season, the numerous runners loop out from the parent plant and root new plants where they touch the ground.

The strawberry belongs to the genus *Fragaria*, a name meaning "fragrance." The "berry" is botanically not a berry at all but an enlarged pulpy receptacle in which the very small seedlike *achenia* (the true fruits) are embedded.

STREAMLINING. All of us have admired the graceful flight of birds and the easy movement of fish. Nature has shaped these creatures so that they scarcely disturb the air or water as they travel. As they move, the air or water divides into streams that flow smoothly over them. We say then that their bodies have *streamlining*.

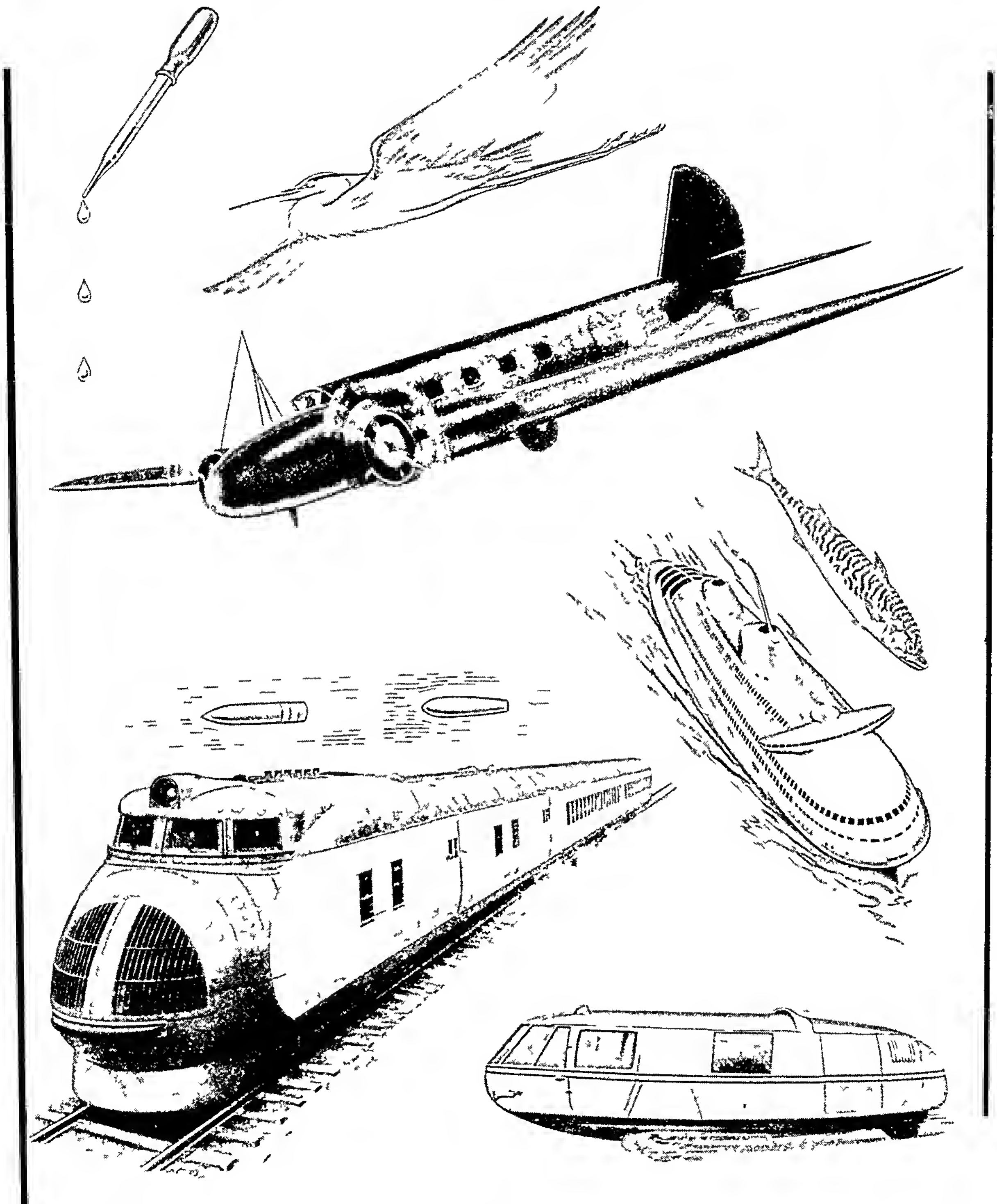
Most streamlined bodies are shaped somewhat like an egg or a drop of water about to fall free. The body has a blunt, oval nose and a more sharply tapered, but still rounded, tail. The surface or "skin" is smooth, and nothing protrudes to break up the even streams. A streamlined body displaces the air or water it moves through without throwing currents to the side or leaving eddies in the rear. An unstreamlined body with projections, sharp corners, and a rough skin causes much turbulence as it moves. The turbulence creates resistance, and additional power is needed to overcome this effect. At high speed the body leaves a partial vacuum around and behind it. Increased pressure ahead of the body also reduces speed. The sum of all the forces that tend to hold an unstreamlined body back is called *drag*.

Applying Streamlines to Vehicles

Men first applied nature's streamlines to ships. Primitive boatbuilders gouged their dugouts out of long, slim logs with tapered ends that passed through the water easily. The ancient Egyptians and Phoenicians constructed vessels with clean lines that cut smoothly through the water and left little wake. The Yankee clipper ships of the 19th century had beautiful streamlined hulls that combined grace and speed. Today even broad-beamed cargo ships taper at bow and stern to provide easy passage through the water.

Not until modern times, however, did men apply streamlining to land vehicles. The first railroad trains,

HOW "STREAMLINING" OVERCOMES "DRAG"



Here we see the "why" of streamlining, which makes it possible for the airplanes of today to fly at such high speeds. This principle has also been applied to dirigibles, steamships, railroad trains, projectiles, and automobiles: Notice first the drop of water falling from the dropper in the upper corner of the picture. Being liquid, it becomes round when it leaves the dropper; but the tailed shape it has just before coming free has been found best for enabling solid objects to get through the air with a minimum of air drag or resistance. This shape, called the streamline shape, consists of a round front and a tapering tail. Most birds and fishes have it. Notice the flying heron, and see how closely its lines are followed by the passenger plane below it. Then compare the swift-swimming mackerel with the ultra-modern lines of Norman Bel Geddes' model of an ocean liner, and see how the same principle is applied to the Union Pacific train which went into service in 1934. Complete streamlining of automobiles does away with the angle between hood and windshield, as in the experimental car pictured at the bottom. How streamlining tends to do away with the "drag" of the vacuum formed behind a speeding object is illustrated by the comparative drawings of the old style rifle bullet and the modern "boat-tailed" bullet. There is much less disturbance behind the latter.

and later the first automobiles, were modeled after the horse-drawn coaches and carriages of their times; and none of them moved fast enough to need streamlining. But as speeds increased with better engines, designers realized that the faster vehicles were being held back because of increased air resistance. So they embodied more streamlining in the new trains and automobiles.

The first streamline train to be placed in daily service was the Burlington Zephyr. It made its initial run Nov. 11, 1934. But a similar design had appeared on paper as far back as 1865. In that year the first United States patent for a streamline train was issued to Samuel L. Calthrop, a clergyman, of Roxbury, Mass. Calthrop's patent foreshadowed practically every modern principle of the streamline train, including fairing of the undergear and joining (articulation) of the cars with flexible covering.

Automobile streamlining began in the late 1920's with the experimental models of Norman Bel Geddes and Walter Dorwin Teague. The automobile industry adopted streamlining gradually so that each year's new models would not represent too radical a change over the previous year's cars. Over several years, automobile designers have substantially rounded the front lines and tapered the rear-end lines. The radiators, fenders, running boards, and headlights have been absorbed into the body. Plastic molding and new methods of stamping body metals have given the cars lines that cause a minimum of drag. The trend toward rear-engine drive means a lower chassis, with even greater streamlining.

Growth of Streamline Planes

The early airplane designers did not realize the need for streamlining. But further studies into aerodynamics convinced them that higher speeds were difficult to attain with bulky, angular wings and fuselage. The engines were expending most of their power in overcoming drag. Today's airplane designs are the results of extensive experiments in wind tunnels (*see* Airplane, section "How an Airplane Is Built"). In the tunnels winds traveling with the speed of sound sweep over airplane structures. From tests like these, designers can learn exactly what shape will permit the smoothest flow of air at high speeds. High-speed photography and smoke streams aid observers in studying wind tunnel effects.

STREET RAILWAYS. In 1922 the street railways of the United States had nearly 44,000 miles of track. Today they have only about 16,000 miles. The chief reason for this decline has been the competition of other forms of transportation—the private automobile, the motorbus, and the trackless trolley.

The biggest decline occurred between 1930 and 1935. During these five years the number of passengers carried decreased almost a third, and the mileage of track operated dropped more than 26 per cent.

Yet, despite this decline, streetcars are still one of the most important agencies of mass transportation in the cities of the United States. Each year they carry more than 9 billion passengers, or 40 per cent of all the people that ride streetcars, motorbusses, trackless trolleys, and elevated and subway lines. To prevent further loss of patronage, they are installing swift streamline cars, almost noiseless because the wheels, axles, and trucks are cushioned with rubber.

In Chicago and other large cities, where great numbers of people must be carried to and from a relatively small central business section, surface transportation is supplemented by rapid transit elevated and subway lines. These can operate at a speed far greater than is possible in surface traffic. They are practicable in territory that offers an abundance of "long haul" traffic, but owing to their high first cost they cannot be made to pay a return on the capital used in building them in territory where traffic is light except during certain "rush hours."

This great network of city and country, surface, elevated, and subway lines had its small beginning in 1832 when the first streetcar, drawn by a team of horses, passed along the streets of New York City. Nearly 30 years later the first street railway in Europe was built in Birkenhead, England, by an American.

ELECTRICITY DOES EVERYTHING BUT COLLECT THE FARES

Here are two views of the first "all-electric" streetcars. Electricity drives the car and operates the brakes, doors, windshield wipers, and all switches on the control panel. The motorman works the accelerator with his left hand and the brake with his right hand. Passengers enter and pay their fares at the rear and leave by the center and front doors. The car seats 58 passengers. It gains speed swiftly but without shock. Magnetically-controlled spring brakes give smooth, quick stops.

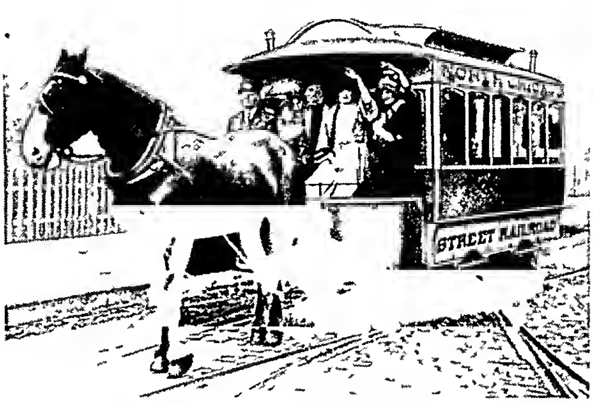
These early streetcars did not look much like modern ones. They were simply coaches drawn by horses over a smooth rail track. But they could go much faster and carry heavier loads than the older omnibuses that jounced over the rough pavements of the day.

Coming of the Cable Cars

The next improvement appeared in San Francisco. In that hilly city horses could scarcely drag heavily loaded cars up the steep streets. Andrew S. Hallidie, a manufacturer of wire rope, decided that a stationary steam engine could do a better job than horses. In 1871 he built the first cable street railway.

An endless belt of hemp-cored wire rope ran from a powerhouse through a conduit below the surface of the street along the length of the line and back. A car could be moved by means of a grip which extended down through a slot in the pavement to the moving cable. When the gripman pulled back on a lever the grip seized the cable and the car was pulled along. The car also had a brake which the gripman used to stop the car as he released the grip.

"RAPID TRANSIT" IN THE 1860'S



This little horse car, only 12 feet long, rolled through the streets of Chicago at the time of the Civil War. In winter straw was spread on the floor to keep passengers' feet warm.

Other American cities soon followed San Francisco in adopting cable cars. Chicago had one of the biggest cable systems with 11 powerhouses and 86 miles of track. But after 1890 many cities began to abandon their cable railways. In Chicago, use of cable cars ended in 1906. Today San Francisco, the first city to have cable cars, is the last to operate them. There the little cars still rattle over the crests of Nob Hill, Russian Hill, and others. One line follows a route laid out in 1876.

Electric Streetcars Take Over

Horse cars and cable cars vanished early in the 20th century because a better carrier, the electric trolley car, had appeared. The first electric car was probably the one made and exhibited by Thomas Davenport in 1835 at Brandon, Vt. It was hardly more than a toy, but it could creep around a circular track, fascinating all who saw it. Later, other experimenters, using stronger motors, got greater speed and power from electric cars.

All these early cars were impractical because they drew their power from batteries carried on the car. The batteries were heavy, expensive, and inefficient and they ran down quickly. But by the 1870's efficient direct-current generators were available. Engineers quickly adopted them for streetcar systems.

In 1874 Stephen Dudley Field successfully ran an electric streetcar in New York City with power from a stationary generator Current flowed from the generator through one rail and back through the other. The car wheels, insulated from each other, picked up the current and fed it to the motor. Some early electric systems used an insulated third rail to supply current and the track rails for the return part of the circuit. Other systems supplied current from a wire in an underground conduit.

Later a pair of overhead wires was used. In some of these overhead systems a little wheeled car ran along the wires. It picked up the current and fed it to the motors through a flexible cable. The little car was called a *trolley*, an old word for small wheeled carts The streetcars using this arrangement were called trolley cars. Later, engineers developed a swiveled pole to take current from an overhead wire, but the name trolley car persisted.

A street railway built in Richmond, Va , in 1888 proved that the trolley car was superior to all other types. The builder, Frank J. Sprague, had been a technical assistant to Thomas A. Edison before he formed a company to build street-railway systems At Richmond he proved for the first time that electric streetcars could climb steep grades. Dramatic tests convinced traction men from other cities that Sprague's cars and power system could meet any demand likely to be put upon them.

From that time electric street railways spread rapidly. Twenty-five years later, electric street-railway companies had nearly 41,000 miles of track. By then only 256 miles of track were operated by horses, cable, or other types of nonelectric power.

Transit Below Ground and in the Air

As traffic on city streets became heavier and heavier, traction companies began to build subways and elevated lines to relieve surface congestion. London had a subway, operated with steam locomotives, as early as 1863. But only a few subways were built in the next 30 years.

In 1897 the first subway line in the United States was opened in Boston, Mass. Surface-line cars ran through a short tunnel below the congested Tremont Street section of the city. Streetcars still run through part of the modern Boston system. Most cities, however, run specially designed subway trains, or in some cases elevated trains, in their subway tunnels.

Elevated railways had been proposed in the 1850's, and in 1858 an experimental line was actually built in New York City. Nine years later, Charles T. Harvey built a line for service on Greenwich Street. It was not successful with cable power, but substitution of steam locomotives gave reliable service.

By the 1890's, "El" lines in some cities were using electric locomotives to haul their trains. These drew power from a third rail. Chicago's South Side Elevated Railroad opened in 1892 with steam locomotives. When the line was electrified in 1897–98 Frank Sprague designed a *multiple-unit* control system. Each car had a driving motor, but connections within the control system enabled the motorman to control all the motors from the front car. With this system any number of cars could be coupled together and run efficiently as a train. The system was adopted for all electric elevated and subway lines and many interurban electric lines.

Suburban and Interurban Systems

During this period of electrification, many suburban and interurban street railroads were built. A suburban road connects the central area of a city with one or more suburbs; an interurban line runs between near-by cities. Both types of railroads carry freight as well as passengers. They usually use fast, multiple-unit electric trains which draw power from a trolley or third rail.

The "interurbans" made it easy for farmers to visit near-by cities and enabled city people to have frequent outings in the country. But as motor vehicles increased in number, the interurban systems steadily lost business to busses, trucks, and private automobiles. Many were forced to abandon service.

New Service to Meet Automobile Competition

More and more city people used their own cars instead of riding the trolleys. In the 1920's many streetcar companies turned to trolley busses (trackless trolleys) to win back lost business. The trolley bus draws power from two trolley wires since there are no rails for return current, but it runs freely on pavement like a motorbus. It can stop at curbs and pass around cars or trucks that would block a car running on rails. Today some cities have replaced all their streetcars with trolley busses.

Traction companies also established the Electric Railway Presidents' Conference Committee to develop an improved rail car. Engineers designed new power units which gave high speed and smooth acceleration. Wheels and trucks were rubber-mounted, and smooth, efficient electric and magnetic brakes were provided. The new car was better heated, ventilated, and lighted than older models. Extra windows were added above the ordinary windows for the benefit of standing passengers. This car, called the P. C. C. (Presidents' Conference Committee) car, was first tried out in 1934. Passengers liked it immediately and it has been adopted in many cities. A picture appears on the first page of this article.

The Modern Street Railway

In earlier days traction companies owned their own power plants, but today most of them buy electric power from utility companies and distribute it through small substations. In the substation, electric converters change high-voltage alternating current to direct current. Most substations have men continually on duty to increase or decrease the supply of current as needed. Some stations have automatic devices and need no attendant.

From the substation the electric current runs at about 600 volts through heavy feeder cables to the trolley wires. A metal pole on top of each streetcar presses a small wheel against the wire to draw off current. From the pole, current passes to a *controller* operated by the motorman. The controller can start and stop the car or change its speed with two devices. It can change the circuits which hook the motors together and thereby change their power output. It can also change power output by cutting resistance elements, called *grids,* into or out of the circuit. Cutting in more grids reduces current and slows down the motors. The grids are carried under the car where they are cooled by the rush of air through them.

Older cars have air brakes and hand brakes for use if the air system should fail (*see* Brakes). The P. C. C. cars have three kinds of brakes: dynamic, magnetic, and hand brakes. The dynamic brake makes the driving motors operate as generators. This develops drag and slows down the car. The magnetic track brake uses the attraction between powerful electromagnets and the track to stop the car. The mechanical hand brake is for emergency use.

In most streetcar systems the return current from the motors travels back along the rails to its source. The current sometimes leaves the rails and travels

ONE OF THE SPEEDY TRACKLESS TROLLEYS

The trolley bus is one successful substitute for the street car. It is fast and can skirt around traffic obstructions. Unlike most streetcars, it must have two trolley wires.

along water and gas mains, causing damage to them (*see* Electrolysis). So some cities require the use of a second trolley wire for the return current. In other cities an underground conduit is used.

Meeting Emergencies

In a big city, men of the streetcar system must meet emergencies constantly. Fires frequently interrupt trolley service. When possible, streetcars are rerouted to avoid streets crowded with fire-fighting equipment. But if the cars must go down a street where hoses are stretched across the tracks, *hose jumpers* are used. Laid on the rails, these permit a car to run over hoses without hurting them. Hose may also be strung up over the trolley wires supported by *tower wagons*. These are trucks with high platforms used for working on the trolley wires.

In winter, snow must be kept from blocking streetcar service. Sweeper cars—streetcars equipped with rotary brooms—are usually sufficient. But for the heaviest snows, powerful snowplows must be used. In northern cities, streets with carlines are sometimes the only ones open to traffic for many hours after an unusually heavy snow.

STRYCHNINE (*strĭk'nĭn*). The alkaloid poisons strychnine and brucine come from a tree found in the East Indies, Australia, India, and southeast Asia. The scientific name of the tree is *Strychnos nux-vomica*. The fruit, the size of a small orange, has from one to five disklike seeds. The poisonous drug nuxvomica is made from these seeds. Strychnine is extracted as white crystals. It can be mixed with powder or rubbed on meat to destroy harmful insects and animals.

South America has a related tree (*Strychnos toxifera*). It yields curare, a powerful poison. Natives use curare on the points of arrows and darts. Both strychnine and curare are used medicinally. Strychnine is used as a heart stimulant and curare is used for treating diseases that cause muscular spasms. (*See also* Poisons.)

STUART. The Stuart line of Scottish and English sovereigns was founded by Robert II. He was the son of Walter Steward and Marjory (daughter of Robert the Bruce). He ruled from 1371 to 1390. Robert III, James I, II, III, IV, V, and Mary in turn ruled after Robert II. Mary, Queen of Scots, changed the spelling to Stuart.

Mary's son, James VI of Scotland, became James I of England after Queen Elizabeth I died. He reigned from 1603 to 1625. Beginning with him and ending with Anne, the Stuarts reigned over both kingdoms. Charles I, 1625–49, came after James I. The Stuart reign was interrupted by the Commonwealth, but was resumed with the restoration of Charles II, 1660–85. The remaining Stuart rulers were James II, 1685–88, his daughter Mary II, who ruled jointly with her husband William III until her death in 1694 (William III reigned alone until 1702), and Anne, 1702–14, another daughter of James II. Anne was the last of the direct Stuart line. (*See also* English History.)

STUART, JAMES EWELL BROWN (1833–1864). In the Civil War, Maj. Gen. "Jeb" Stuart was the South's most brilliant cavalry leader. (His nickname came from the initials of his given names.) Stuart's hard-riding troopers formed a screen between General Lee's Confederate forces and the Union armies. Behind that screen Lee secretly moved his armies at will. Stuart also spied out Northern army movements and kept Lee well informed.

"JEB" STUART

This dashing young general was Lee's great cavalry leader.

The South loved Stuart for his great feats and for his spectacular personality. A flaring brown beard hid much of his youthful face. His cloak was lined with red; his lean waist was draped with a yellow sash; and his hat sported a plumed feather. Whenever the opportunity came he loved dancing and parties.

Stuart was born on Laurel Hill plantation, in Patrick County, Virginia, on Feb. 6, 1833. When he was ten, an encounter with hornets showed the stubborn determination that he later employed as a general. While an older brother fled, young Jeb narrowed his eyes against the angry stings. With a stick he dashed the hornets' nest to the ground.

He received his early schooling from his mother and tutors. He entered Emory and Henry College when he was 15 years old. Two years later he was appointed to West Point. He was a popular cadet and famed for his eagerness to fight all comers. As a lieutenant he served against the Indians in the West. Stuart was Lee's aide at the capture of John Brown at Harpers Ferry. When the Civil War broke out, Stuart resigned his commission and joined the South.

The Confederates made Stuart a lieutenant colonel. At the first battle of Bull Run (1861) his cavalry protected the Southern left and drove forward in a charge that aided victory. In 1861 Stuart was promoted first to colonel and then to brigadier general. In 1862, then only 29, he was made a major general.

Stuart's raids became famous. Once, with 1,200 troopers, he circled McClellan's army before Richmond (1862). Again, with 1,800 men, he drove north into Chambersburg, Pa. (1862). When "Stonewall" Jackson was fatally wounded at Chancellorsville (1863), Stuart took command of his troops and gained a notable victory (*see* Jackson, Thomas Jonathan).

Stuart was mortally wounded at Yellow Tavern when he threw his thin divisions between Richmond and the threat of Sheridan's strong cavalry command. He died in Richmond on May 12, 1864. Stuart was married and the father of three children. After his death General Lee said of him: "He was my ideal of a soldier." (*See* Civil War, American; Lee, Robert E.)

The SECRET *of* SUCCESSFUL STUDY

STUDY. The first essential of efficient learning is the desire to learn. When interest is intense, learning is fast and easy. One does not have to study. One learns as easily as one breathes. The five-year-old is too immature to learn very complicated things, but he illustrates one important aspect of efficient learning. His curiosity is unending. He is interested in everything. One question follows another in rapid succession. "What is it?" "Where did it come from?" "What's it for?" "What does it do?" "Will it hurt me?" "Then why can't I have it?" If we could carry such curiosity into the schoolroom and focus it on school subjects there would be no need for discussions on how to study.

Pupils do have questions, but they are usually about topics other than those studied in school. In the usual classroom the teacher asks and the pupil must find the answers. This means study. It means less time for games, hobbies, motion pictures, television, and other activities. For this very reason a student should be interested in learning how to study efficiently. If he uses good study techniques he can reduce the time used in study and learn more easily.

Bill makes good grades even though he does not spend too much time studying, and he has time for everything else. John grinds away day after day, yet *his* grades do not show it. Of course, Bill may be brighter and study may come easier to him. It may be that Bill is one of those rare persons who like to study. The chances are, however, that he saves time for other things by using good study methods.

Interest Makes Study Easier

The first problem is to generate interest, to develop strong motivation. Even a genius fails to learn efficiently unless he is interested in what he is doing. How can interest be aroused when it is not there? The answer is that a student should consider *why* he studies. He studies because it is costly to be ignorant. What he learns in school is important now and in the future. It is the foundation for success, not only in earning money but in living a full and rich adult life. Moreover, he needs good grades so that he can advance with his friends to higher levels of learning. High-school students often realize too late that they have been left behind. Their grades are not good enough to admit them into a college or university or to qualify them for the best jobs. Then they regret that they had not shown more interest.

Planning Study Periods

The next step in effective study is to work systematically. It is easy to waste time and accomplish nothing. The best plan is to set aside certain hours for study. If possible, a specific time should be scheduled for each subject. It may be necessary to try out different schedules before a satisfactory arrangement is found. This should be one to which the student can adhere with reasonable faithfulness. Even if he cannot keep strictly to his schedule, he is still better off than with none at all.

Another point to remember is that he should not study when tired. In making a schedule it is well to allow for rest periods every half hour or at least every hour. The person who cannot concentrate at once had better arrange for a rest period after each hour. He will find too much of a half-hour period gone before he gets much accomplished.

Rest periods need not be long. Five to ten minutes will do. The interval should be spent in relaxing, not in studying something else. It is better to get up and relax somewhere else than at the study desk.

If a rest is to be followed by some subject other than that just studied, the schedule should be arranged so as to make the second subject as different as possible from the earlier one. The reason for this is that whenever a person studies one thing and follows it by the study of another, the second interferes with retention of the first (*see* Memory). Such interference is not too great if he returns to the same subject after his rest. However, suppose he is studying mathematics, which requires intensive application, then chemistry, which is also difficult. The chemistry may weaken or wipe out some of the mathematics he just learned. He would have done better to schedule English or social studies between mathematics and chemistry. What is easy for one student may be difficult for another. The student himself is the best judge of what he should sandwich between subjects. If he *must* follow one difficult subject with another, a rest period will itself remove some of the interference between them.

The most effective study is done in a place especially reserved for it. Whenever possible, he should study in the same place, at the same desk. It is then much easier to concentrate. He develops the habit, when in this place, of keeping his mind on study. A student who has difficulty in concentrating is usually not sufficiently isolated from distractions. Music helps some but distracts others. Hardly anyone can concentrate when he hears talking. If items on the desk distract, they should be removed. Illumination should be sufficiently bright and, if possible, indirect (*see* Lighting).

How to Study

Having arranged a workable schedule, adequate rest periods, a good sequence of subjects, and a place where distractions are reduced to a minimum, the student is ready to apply some helpful study hints.

The first step in studying an assignment should be to give the material an over-all examination. Skim through it. Survey what must be covered. Some aspects, as revealed by the brief survey, may need relatively little attention. Others may call for careful study. After these parts have been studied, return to the over-all picture to see how things tie together.

When problems are to be solved, sentences analyzed, or places identified on a map, there is little he can do but work. There are no short cuts. When lists, poems, or other materials are to be memorized,

a self-recitation procedure will be very helpful. First of all read the material through once, trying to memorize it. Then try to recall the first part. Check by looking at the copy. Try to recall the next part. Check, then go to the next, and so on until the end is reached. Follow this procedure until the whole assignment is recalled without error and without looking at the copy. Running over the material a few more times will help to fix it better for recall later. Some such recitation procedure is much more effective than a mere reading of the material over and over without attempts to recall it from memory. Time is saved and retention is improved. Retention is further improved when there is later review.

When the assignments involve history, literature, and other subjects which do not require word for word memory, recitation may take a somewhat different form. After his initial survey, when he gets down to the study of separate paragraphs, the student should ask himself: "What is the writer trying to tell me?" "What should I get from this?" "What questions will the teacher ask?" His study can then take the form of seeking answers. This provides motivation. It helps to keep the mind from wandering. If the teacher's questions can be anticipated, it is also good practice for examinations.

Above all the student should strive for understanding. Memorizing word for word is foolish. It is also foolish to take very detailed notes, and this applies to lectures as well as to study. If he gets the meaning, a mere outline is sufficient for later review. Too much concentration on details can actually take attention from the main issues. This weakens his understanding. It is always well for him to put things into his own words as much as possible and to try to fit them into his own experience.

In reading textbook assignments he should not skip over the illustrative materials. They are placed there to add meaning. Each graph should be examined for what it tells about the issue dealt with in the text. Each picture and its legend should be examined and related to other aspects of the assignment. He should not copy graphs or other pictures but try to gather understanding from them.

The student who plans his study as suggested and who applies the psychological principles outlined above should find that he has more time left for other things. His grades should also improve. What is more important, he should gain a better understanding of what he studies and improve his ability to apply what he learns (*see* Learning).

STURGEON. Caviar and one of the best kinds of isinglass are two valuable products we get from the sturgeon. Caviar is prepared from the eggs (roe), which the female lays by the millions. Isinglass is made from the inner membrane of the fish's air bladder. The flesh is sometimes eaten fresh, but it is usually preferred smoked.

The sturgeon is a large bulky fish with a long body, skin covered with five rows of large bony plates, and a tapering snout. There are about 25 species, varying greatly in size. Specimens 8 to 11 feet long are by no means rare. One species of the Black and Caspian seas grows to be 24 feet long and to weigh 2,000 pounds. On the other hand, some are rather small. The sterlet rarely exceeds a length of 3 feet.

Most species live in the sea a great part of the year, ascending rivers to spawn. A few, such as the sturgeon of the Great Lakes, are exclusively confined to fresh water. Sturgeon are found only in the Northern Hemisphere. They occur in greatest abundance in southern Russia, where the fisheries are of immense value. In the United States the chief fisheries are in the Columbia River. Most sturgeon belong to the genus *Acipenser.*

STUYVESANT (*stī'vĕ-s'nt*), PETER (1592–1672). In 1664 the British seized the Dutch settlement of New Amsterdam and renamed it New York. They met no resistance, because the inhabitants were glad to escape the rule of their Dutch governor, Peter Stuyvesant.

Stuyvesant was born in the Netherlands, the son of a clergyman in the Dutch Reformed church. He entered military service for the Dutch West India Company, and by 1643 he had risen to be governor of Curaçao and other islands. In 1644 he led an attack upon the Portuguese in the island of Saint Martin and lost a leg. He returned home to recuperate and in 1645 he married Judith Bayard. They had two sons.

At the time, the Dutch in New Netherland were disgusted with their governor, William Kieft. In 1646 the States-General made Stuyvesant director general of the Dutch possessions in America, and he arrived at New Amsterdam May 11, 1647.

He was determined to be "as a father over his children," and he set about trying to reform abuses. Many of his measures were excellent, and he strengthened Dutch power in the region; but his despotic character and his blunt manner soon made him many enemies.

He tried to regulate the sale of liquor and forbade its sale to the Indians; but his orders were disregarded. His attempt to give the inhabitants of New Amsterdam a monopoly of the fur trade was met by smuggling. He punished those who would not conform to the Dutch Reformed church, and he opposed giving the people a share in the government. Instead, he named a council of nine men to advise him. A protest to the States-General finally won a popular city government in 1653.

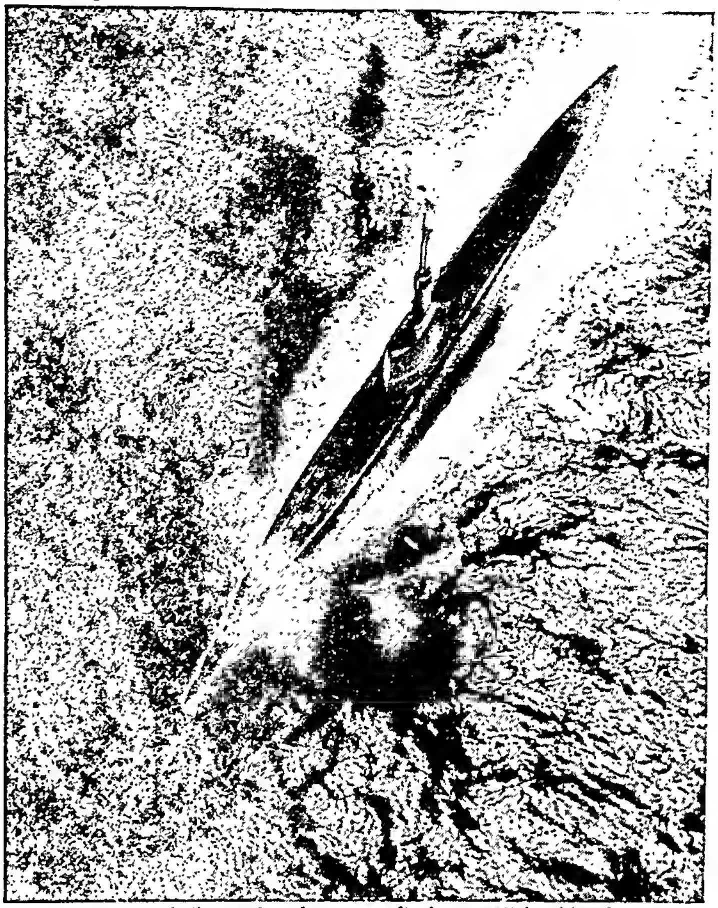
These troubles made the inhabitants ready to welcome English rule when war broke out between the Dutch and the British. The city was defended by a stone fort and 20 cannon; but when British warships appeared in the harbor in 1664, the people refused to resist the invaders. Stuyvesant was forced to surrender, and New Amsterdam became New York.

Stuyvesant returned to the Netherlands. But the Dutch West India Company blamed him for their misfortunes in the New World, so he returned to America. He spent the rest of his life on his farm, or "bouwerij," as it was called in Dutch. On the site of this farm now runs the street named after it—the Bowery—on the lower east side of New York City.

Deadly SUBMARINES *of the* SILENT SERVICE

SUBMARINE. Among the important defenders of the United States are the men who wear the twin-dolphin insignia of the Submarine Force on their navy uniforms. Their duty is called "the silent service," because submarines are designed to operate by stealth. They move under water to approach enemy vessels and deliver surprise attacks with torpedoes.

Submarine duty is extremely hazardous, and at sea the men must live in cramped, often uncomfortable, quarters. The men who share these dangers and discomforts remain companions when they are ashore, as if they were members of a club. They call themselves "submariners," pronouncing it *sub-mar'iners.* They call their submarines "subs" or "boats."



The clean, smooth lines of undersea craft show well in this picture of a modern submarine. The boat is cruising at the surface through a rough sea, using Diesel engines for power.

Construction of a Submarine

Every feature of a submarine is designed for operation either on the surface or submerged. The streamlined hull is shaped somewhat like a fast-swimming fish, such as a pickerel or a barracuda. A turretlike superstructure rises from the deck a little forward of the middle of the boat. The taller part of this structure, called the *sheers,* houses periscopes and other equipment that can be raised and lowered. A low bridge bulges out forward of the sheers. Within the structure, invisible from outside, is the *conning tower.* Here most of the navigating equipment is grouped. On big submarines the line of the deck is broken by deck guns forward and aft of the bridge.

The hull is made of steel plates welded or riveted together. In cross section it is circular or elliptical. This shape gives maximum strength and keeps the hull from being crushed by the pressure of deep water. Modern submarines can go down more than 600 feet without damage. Smaller boats have only one hull. Larger ones have a thick inner hull (*pressure hull*) and a thin outer one. The space between contains ballast tanks and fuel-oil tanks. These help protect the inner hull against shells, torpedoes, ramming, and other dangers.

A SUBMARINE'S STINGS

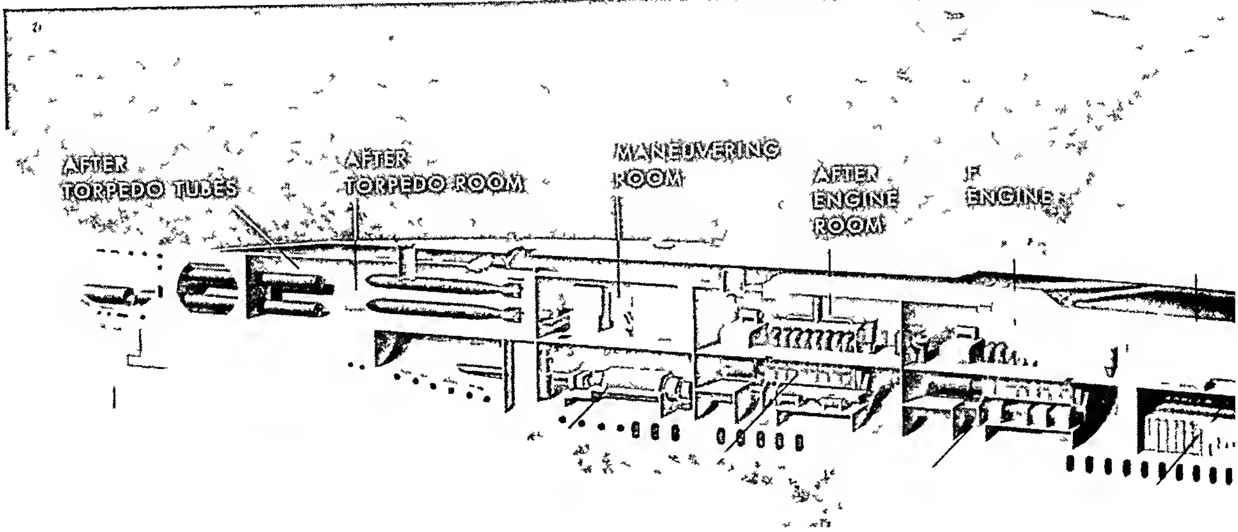
A combat submarine exists for one purpose—to destroy the enemy with its torpedoes. Here in a tightly crowded compartment are the four after torpedo tubes of a modern submarine.

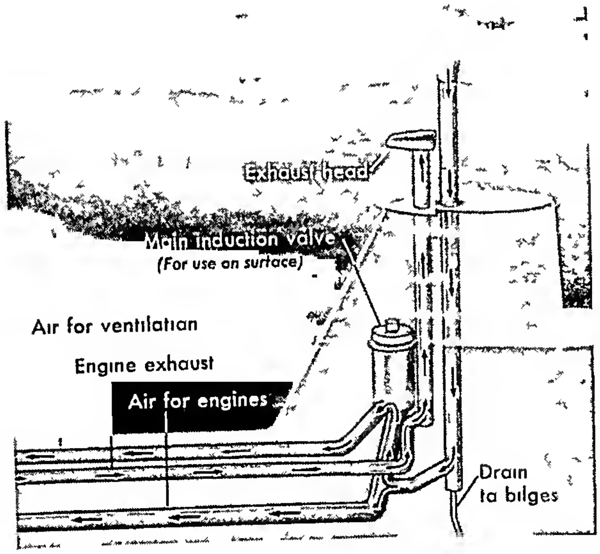
How a Submarine Dives and Stays Below

A boat submerges by letting sea water into ballast tanks. To rise it blows the water out with compressed air. This is stored in steel flasks at pressures as high as 3,000 pounds to the square inch. *Hydroplanes* assist in submerging. These are movable horizontal fins at the bow and stern. Ordinarily they are tilted slightly and the boat sinks on an even keel. In a *crash dive* to escape an enemy they are tilted sharply, and the vessel goes down at a steep angle. When a submarine is surfaced, the bow planes fold into the side of the hull.

To run below the surface, a boat takes on just enough ballast to leave it a little lighter than the water it displaces. Then it runs with its bow and stern planes tilted to keep it at the chosen depth. If an enemy is hovering near it may drop down to the bottom and lie

A SUBMARINE CREW MUST LIVE IN TINY BITS OF





The cutaway picture above shows how a modern guppy submarine is laid out below decks, with mere scraps of space for the crew. Most other types are similar. The snorkel (left) allows a submarine to "breathe" under water. The intake head just above water supplies fresh air for the Diesel engines and for ventilation.

quiet in fairly shallow water. To keep the submarine in trim, weight must be added as fuel and stores are consumed. Fuel-oil tanks admit water as fuel is used. Water is also admitted as torpedoes are fired.

For cruising on the surface, a large submarine has four Diesel engines. Only two are needed for moderate speed. With all four, a modern submarine can make 20 knots or more. Submerged, a submarine may be driven by electric motors drawing power from batteries. Top speed on battery power is about 17 knots. The batteries are charged by generators driven by the Diesels during surface runs. One night's charging enables the submarine to travel all next day on batteries.

Breathing with a Snorkel

Until the end of the second World War, submarines could stay below water at most about 30 hours. Then they had to come up to recharge the batteries because outside air is needed for running Diesel engines. Since the war many submarines have been equipped with a *snorkel* (from the German *Schnörkel*), which permits them to run Diesel engines under water. An air intake tube is extended up to the surface. Blowers draw down air for the Diesels and the ventilating system. If a high wave strikes the intake, an automatic valve closes the snorkel. Any water that does get in is trapped and dropped into the bilges. Engine gases are exhausted through another tube below the surface. While "snorkeling," a submarine can travel at about 12 knots.

The snorkel was invented by J. J. Wichers, a Dutch naval officer. The Germans captured a snorkel-equipped Dutch submarine and adopted the device. After the war the United States Navy and others developed improved snorkels.

Navigating a Submarine

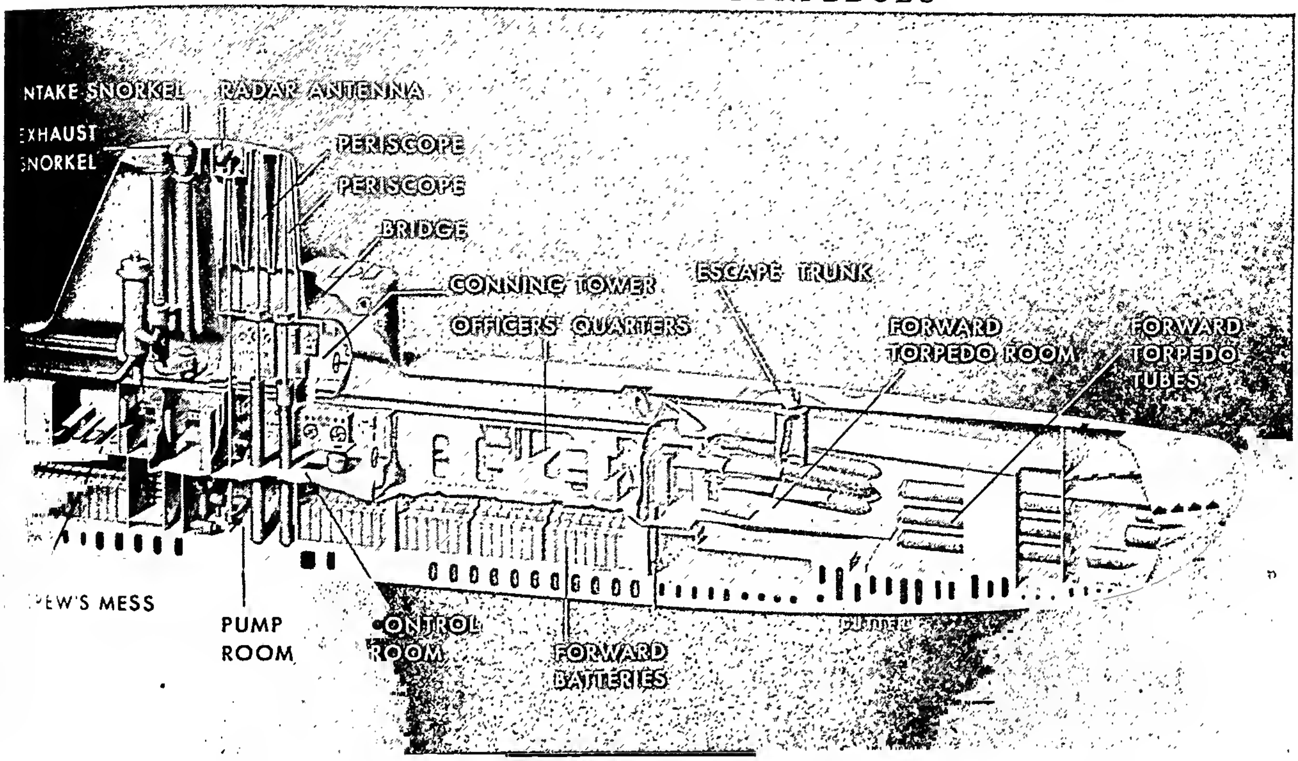
Whether a submarine is running submerged or surfaced, the helmsman usually stands his watch at the wheel in the conning tower. When the boat is surfaced he relies on orders from the bridge above. When it is submerged an officer at the periscope gives him orders.

Most submarines have two or more periscopes for scanning the surface when the boat is submerged (*see* Periscope). A periscope can be raised until its tip stands about 40 feet above the hull. The periscope itself is inconspicuous but it leaves a telltale wake. When enemy ships are near by the tube is drawn down and the submarine runs blind. Then the helmsman steers with the gyrocompass (*see* Gyroscope).

History of the Submarine

The idea of an underwater boat that could run unseen has long appealed to man. A Dutchman, Cor-

SPACE AMONG THE MACHINERY AND TORPEDOES

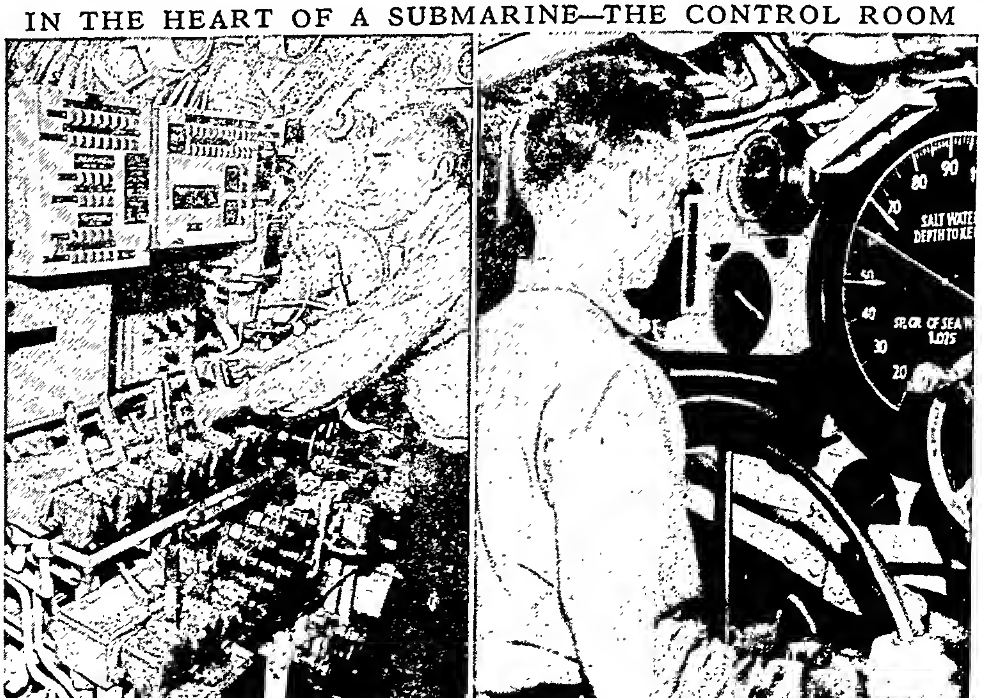


nelius van Drebbel, is said to have invented a craft which was rowed beneath the surface of the Thames in 1620. David Bushnell's *Turtle* was used in 1776 in an unsuccessful attempt to blow up a British warship in New York harbor. Robert Fulton built a submarine and blew up targets with it, first before Napoleon and then for the British prime minister Pitt. But no one then showed interest. The Confederate craft *Hunley* blew up the U.S.S. *Housatonic* in Charleston harbor Feb. 17, 1864, but was itself destroyed.

All these earlier submarines lacked proper propelling machinery. John P. Holland overcame this defect by using a gasoline engine on the surface and electric motors under water when he built the *Holland No. 9* for the United States Navy in 1898. Simon Lake also designed submarines at this time but could not win American recognition. Then Russia employed him, and before the first World War the United States was giving him large orders.

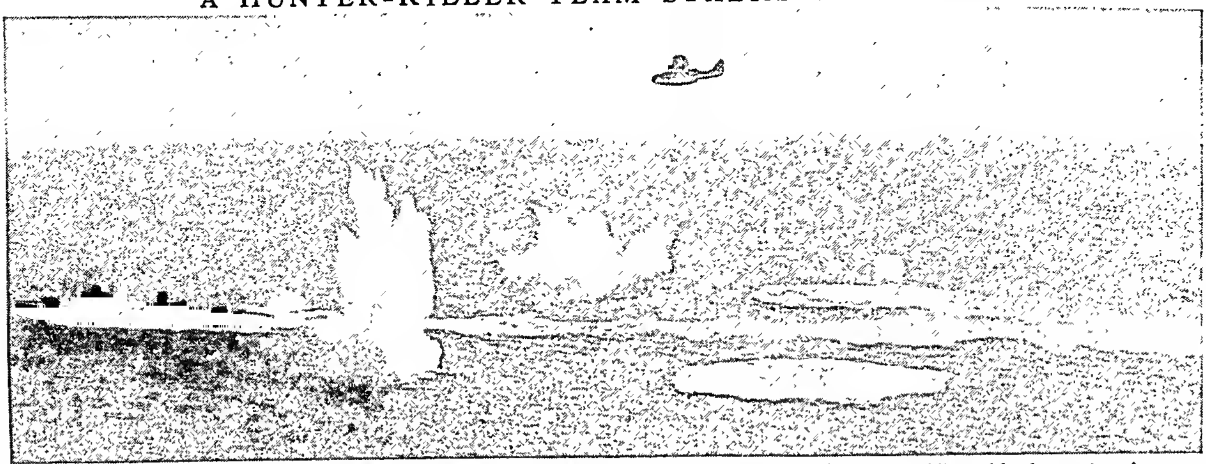
Submarines came to the fore as a powerful naval weapon in the first World War. German U-boats sank millions of tons of shipping before the Allies devised successful countermeasures. (The term U-boat was from the German *Unterseeboot*, "under-sea-boat.") In the second World War the principal warring nations made effective use of submarines. The United States

IN THE HEART OF A SUBMARINE—THE CONTROL ROOM



The chief petty officer of the watch (left) is opening ballast-tank vents in preparation for a dive. The board (called the "Christmas tree") indicates whether vents are open or closed. At the right the submarine is cruising at periscope depth. The seaman is handling the bow planes.

A HUNTER-KILLER TEAM STALKS THE ENEMY



The hunter-killer team shown here is an effective defense against enemy submarines. A plane or blimp (the hunter) cruises over the water and when it spots a submarine signals an accompanying destroyer (the killer). The destroyer then moves in over the submarine and drops a pattern of depth charges as it is doing here. These may sink the submarine or force it to come to the surface.

concentrated on 2,000-ton boats with a cruising range of 12,000 miles. Germany, for the most part, used smaller boats of about 750 tons. Japan built submarines of all sizes, from midgets to the enormous *I-400*, which displaced 5,500 tons.

The United States *guppy* class was a postwar development. (The term "guppy" is from Greater Underwater Propulsion Program.) These high-speed craft were equipped with snorkels. *Killer* submarines were designed to destroy enemy submarines. The world's first atomic-powered submarine, the *Nautilus*, was launched in 1954. (For picture *see* Navy.) Details were "top secret" but the power plant was probably a turbine, driven by steam generated in an atomic reactor (*see* Atoms). Another type of submarine was the British *Explorer*, launched in 1954. Part of its underwater power came from the use of hydrogen peroxide.

In the first World War, destroyers proved best for fighting submarines. Their guns could destroy a submarine on the surface. If it submerged they destroyed it with depth charges. These have fuses that can be set to explode the charges at any depth.

In the second World War the Allies supplemented their patrols of destroyers with great numbers of smaller vessels—corvettes, destroyer-escorts (DE's), patrol craft (PC's), and sub-chasers (SC's). Planes based on escort carriers (CVE's) also proved effective.

Radar can frequently detect a submarine if no more than its periscope is above water (*see* Radar). For this reason, snorkels and other projecting equipment are often coated with a substance which cuts down radar reflections. To find a submerged submarine, navies also use *hydrophones* and *sonar* equipment. Hydrophones are installed under water on each side of the ship. The one nearer the submarine hears the sound of its engines more strongly. The adjustment needed to make the two sounds equal reveals the direction of the submarine. A sonar transmitter sends a supersonic beam through the water. If the beam hits a submarine, it echoes back to the receiver. The time taken for the echo to return reveals the distance. The sonar receiver can also be used for listening. Submarines in turn use these devices to detect surface ships and aim torpedoes.

Escape from a Submarine

When a submarine is damaged and sinks in water that is not too deep, the crew can often be rescued. If a surface ship can maneuver over the submarine, it can lower a rescue bell and bring men up inside it.

Men can also escape with the help of the *Momsen lung*. A man's nose is closed by a clip and he breathes oxygen and air from a flask strapped to his chest through a mouthpiece gripped in his teeth. To avoid too sudden a change of pressure, he climbs slowly up a rope which has been carried to the surface by a float from the submarine's escape hatch. In this way escapes can be made from depths of 100 feet or more.

ESCAPE FROM A DISABLED SUBMARINE

These men are practising escape procedure in a pressurized compartment at submarine school. The man wearing the Momsen lung will duck under water and up through the escape trunk to the surface.

This boy plans to spend 15 of his 30 pennies. To find out how many will be left, he can take away 15 pennies one by one and then count those that remain. Subtraction is a much quicker way.

SUBTRACTION—*A Basic* ARITHMETIC SKILL

SUBTRACTION. Suppose that a child has 30 pennies and plans to spend 15 of the pennies for a ticket for a school play. How can he find out how many pennies he will have left?

If the child does not know how to subtract, he can spread the 30 pennies on the table, take away 15 pennies one by one, and then count the pennies that remain. Or he can make 30 tally marks, cross out 15 of the marks, and count the remaining marks.

If the child knows how to subtract, he can write the numbers 30 and 15 in the form of the example on the blackboard and find the remainder by subtraction. If he thinks in the following way, we can be sure that he not only knows the process but that it is meaningful to him:

Because there are no ones to subtract from in 30, I must change one of the 3 tens to 10 ones, making in all 10 ones with 2 tens remaining in tens' place. Then $10-5=5$. Write 5 in ones' place in the answer. Because only 2 tens remain, I must think: $2-1=1$. Write 1 in tens' place in the answer.

$$\begin{array}{rcl} 30 = & 20+10 & \\ \underline{-15} = & \underline{-10+\ 5} & \\ & 10+\ 5 & =15 \end{array}$$

The meaning of the method the child used in working the example is shown at the left. The meaning can also be shown with dimes and pennies as follows: 30 cents is the same as 3 dimes and no pennies. To take away 15 cents from the 3 dimes, one of the dimes must first be changed to 10 pennies. Then there are 2 dimes and 10 pennies. To subtract 15 from 30, take away 5 pennies and 1 dime. Then 15 cents remains.

The method of subtraction described above is known as the *decomposition* method. In this method, the upper number, 30 (3 tens), is regrouped as 2 tens in the tens' place and 10 ones. This step is often called "borrowing." The decomposition method can easily be demonstrated with objects and markers. Then it is quickly learned.

Another method of subtraction that is sometimes taught is called *equal additions*. This method is shown by the work in the example at the left.

$$\begin{array}{rrl} 30 & 30+10 & \\ \underline{-15} & \underline{-20+\ 5} & \\ & 10+\ 5 & =15 \end{array}$$

First, to get some ones in the upper number, 10 ones are added to this number. Because 10 ones are added to the upper number, 1 ten must also be added to the lower figure in tens' place. Then we subtract as shown in the example. No satisfactory way of demonstrating the meaning of this method has been devised. Therefore, in schools where meanings are stressed, the decomposition method is taught because it can be demonstrated.

Subtraction examples such as $34-12$ and $36-20$ are easy to work because no regrouping is required.

Four Different Uses of Subtraction

A. ○○○∅∅ B. ⊖⊖⊖○○ ⊖⊖⊖ C. ○○○○○ D. ○○○●●

A answers the question: If we take away 2 from 5, how many remain? This is the simplest and most common use of subtraction.

B answers the question: How much more than 3 is 5? Here we compare two numbers.

C answers the question: If I have 3 pennies, how many more must I get to have 5 pennies in all? Here we subtract 3 from 5 to find how many more pennies are needed.

D answers the problem: There are 5 balls, some black and some white. I know that 2 are black. How many are white? Here we know the total of two amounts and also one of the amounts; we subtract to find the other amount.

HOW TO PRACTICE THE 100 SUBTRACTION FACTS

7	9	0	4	8	2	5	3	6	1
0	0	0	0	0	0	0	0	0	0
7	9	0	4	8	2	5	3	6	1
5	1	9	7	4	8	3	6	2	10
1	1	1	1	1	1	1	1	1	1
4	0	8	6	3	7	2	5	1	9
8	6	5	3	7	9	4	2	10	11
2	2	2	2	2	2	2	2	2	2
6	4	3	1	5	7	2	0	8	9
3	9	6	4	7	12	8	10	5	11
3	3	3	3	3	3	3	3	3	3
0	6	3	1	4	9	5	7	2	8
9	13	4	8	10	5	7	11	6	12
4	4	4	4	4	4	4	4	4	4
5	9	0	4	6	1	3	7	2	8
6	11	9	5	8	14	10	7	13	12
5	5	5	5	5	5	5	5	5	5
1	6	4	0	3	9	5	2	8	7
7	11	15	10	8	6	14	9	12	13
6	6	6	6	6	6	6	6	6	6
1	5	9	4	2	0	8	3	6	7
7	16	11	14	9	13	8	12	10	15
7	7	7	7	7	7	7	7	7	7
0	9	4	7	2	6	1	5	3	8
9	12	17	10	15	14	8	11	16	13
8	8	8	8	8	8	8	8	8	8
1	4	9	2	7	6	0	3	8	5
9	12	18	10	17	13	11	16	14	15
9	9	9	9	9	9	9	9	9	9
0	3	9	1	8	4	2	7	5	6

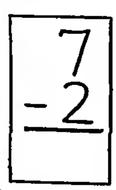
Special work on the subtraction facts with this chart will increase both speed and accuracy in working longer subtraction examples. Incorrect answers to longer subtraction examples are more often traced to errors in number facts than to any other cause.

1. Begin with row 1. Read the first fact. Then close your eyes and say the fact to yourself several times. For more practice on any fact, write it three or four times on a sheet of paper.

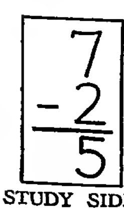
2. Cover the answers of a row of facts with a strip of paper and write the answers on the paper. Then slide the paper down to see whether all your answers are correct. Make a list of all facts for which you write incorrect answers and do special work with them.

3. Cover the answers to a row of facts with a card. Give the answer to the first fact. Then slide the card one space to the right to see whether the answer you gave is correct. Do the same for the remaining facts in the row. This oral drill will speed up your work because you will not have to take the time to write the answers.

4. Have someone read the facts to you one at a time. You say the answer and the person reading to you checks it. Keep a list of the facts for which you give incorrect answers and make test-study cards for them (*see* below).



TEST SIDE



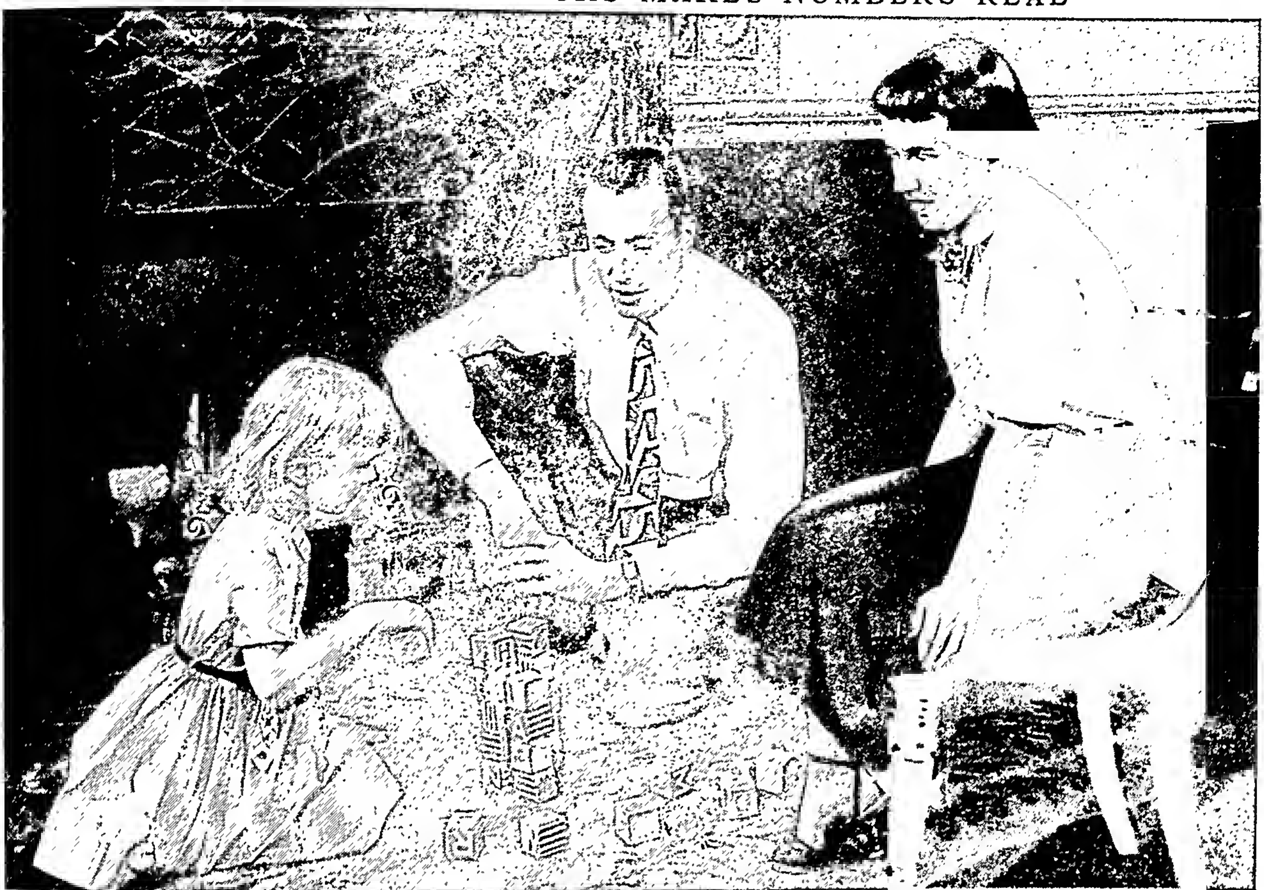
STUDY SIDE

HOW TO MAKE AND USE TEST-STUDY CARDS

On one side of a 3 × 5 inch card write the example without the answer. This is the test side. On the other side of the card write the example with the answer. This is the study side. Use objects or markers to test the answer for any fact that you are not sure of.

Stack the cards with the test sides face up. State the answer to the example on the top card, then turn it over to see whether your answer is correct. Put aside those you answer correctly and quickly. Replace at the bottom of the stack, or put in a separate pile, those that need further study.

PLAYING WITH BLOCKS MAKES NUMBERS REAL



This little girl will be ready for arithmetic when she enters school. She made no mistakes when her father asked her to build towers of five blocks each. Now she is discovering a subtraction fact—that four are left when she takes one from five.

When a child cannot decide on the operations to use to find the answers to problems, it is likely that he does not know the meaning of the processes. In general, subtraction means "separating" or "taking apart" numbers. When we subtract, we *find the difference* between two numbers. This is the opposite of addition, since when we add we "join" two or more numbers to find their sum.

When a young child at play with 5 blocks discovers that 4 blocks remain when he takes away 1 of the blocks, he has sensed the basic meaning of subtraction. When he takes away 2 of the 5 blocks, he sees that 3 blocks remain. Any subtraction number fact can be made meaningful to a child by manipulating in this way objects or markers of various kinds.

There are in all 100 basic subtraction facts. They are grouped for study and practice in the chart on the opposite page.

Steps in Teaching Subtraction Examples

A number of basic skills must be learned to work subtraction examples. These skills should be introduced slowly and gradually, proceeding from the simplest procedures to those that are the most difficult.

TERMS USED IN SUBTRACTION

8	*Minuend*	The minus sign (−)
−2	*Subtrahend*	says *subtract.*
6	*Remainder, or Difference*	

The series of graded examples below shows the steps and the order in which they should be learned. The thinking that the child should be taught to do as he proceeds from step to step is given with each example.

Step I. Easy examples:

$$\begin{array}{r} 65 \\ -42 \\ \hline 23 \end{array}$$

Begin with the ones' column. Subtract the ones.
Think: 5−2=3. Write 3 in ones' place.
Now subtract the tens.
Think: 6−4=2. Write 2 in tens' place.
No regrouping is required.

Step II. Regrouping in subtracting two-place numbers:

$$\begin{array}{r} 34 \\ -18 \\ \hline 16 \end{array}$$

Begin with the ones' column. Because 4 is less than 8, I cannot subtract. I must get more ones. So I shall take 1 of the 3 tens and change it to ones, making in all 14 ones.

$$\begin{array}{r} {\scriptstyle 2\ 14} \\ \cancel{3}\cancel{4} \\ -1\,8 \\ \hline 1\,6 \end{array}$$

Now subtract 14−8=6. Write 6 in ones' place.
Subtract 2−1=1. Write 1 in tens' place.
To check the answer, add 18 and 16. The sum is 34, the same number as that from which I subtracted 18. So the work checks.

The second written example in Step II shows the "thought numbers" resulting from the regrouping for decomposition subtraction. Showing "thought numbers" is a learning aid, useful in demonstrating the step. It should not be used after the step is understood by the child because it slows the process.

The regrouping procedure can be demonstrated to children in several ways by using objects. One way is to use dimes and pennies. Another way is to show the step with bundles of sticks and single sticks. Still another helpful way is to demonstrate the step with place-value pockets and bundles of 10 cards and single cards as shown at the bottom of this page.

When children understand the method of regrouping, they very easily learn the steps of regrouping shown in the following examples with three-place numbers:

Step III. Regrouping in ones' place:

$$\begin{array}{r} {}^{7\ 12} \\ 3\cancel{8}\cancel{2} \\ -146 \\ \hline 236 \end{array}$$

Check the answer by adding 146 and 236. The sum should be the same as the upper number.

Step IV. Regrouping in tens' place:

$$\begin{array}{r} {}^{3\ 12} \\ \cancel{4}\cancel{2}8 \\ -298 \\ \hline 130 \end{array}$$

Check the answer by adding 298 and 130.

Step V. Regrouping in both ones' and tens' places:

$$\begin{array}{r} {}^{3\ 11\ 16} \\ \cancel{4}\cancel{2}\cancel{6} \\ -148 \\ \hline 278 \end{array}$$

Check the answer by adding 148 and 278.

For practice on these steps in subtraction, use the practice exercises in a modern arithmetic textbook or workbook. It is important that parents, in helping their children learn subtraction, use the method of subtraction taught by the child's school. For example, when the decomposition method is taught in the school, it should be used in the home in preference to the equal additions method.

It is interesting to note that subtraction is used in working many division examples, as shown in examples A and B:

SPECIAL HELPS IN LEARNING SUBTRACTION FACTS

The row of facts below illustrates some general ideas that help children to learn subtraction facts and to organize their meanings.

$$\begin{array}{r} 8 \\ -1 \\ \hline 7 \end{array} \quad \begin{array}{r} 4 \\ -0 \\ \hline 4 \end{array} \quad \begin{array}{r} 5 \\ -5 \\ \hline 0 \end{array} \quad \begin{array}{r} 6 \\ -5 \\ \hline 1 \end{array} \quad \begin{array}{r} 12 \\ -9 \\ \hline 3 \end{array} \quad \begin{array}{r} 15 \\ -6 \\ \hline 9 \end{array} \quad \begin{array}{r} 7 \\ -2 \\ \hline 5 \end{array}$$

When we subtract 1 from a number, the remainder is 1 less than the number. The fact $8-1=7$ shows this.

When we subtract 0 from a number, the answer is the same as the number. The fact $4-0=4$ shows this.

When we subtract a number from itself, the remainder is 0. The fact $5-5=0$ shows this.

When we subtract from any number the next smallest number, the remainder is 1. The fact $6-5=1$ shows this.

Subtracting 9 from a number is the same as subtracting 10 and then adding 1 to the remainder. The fact $12-9=3$ shows this.

The remainder is 9 when the upper figure in ones' place is 1 less than the figure below. The fact $15-6=9$ shows this.

To subtract 2 from a number, skip a number going down the number scale. The fact $7-2=5$ shows this.

A
$$\begin{array}{r} 7 \\ 4\overline{)30} \\ \underline{28} \\ 2 \end{array}$$

B
$$\begin{array}{r} 7 \\ 24\overline{)182} \\ \underline{168} \\ 14 \end{array}$$

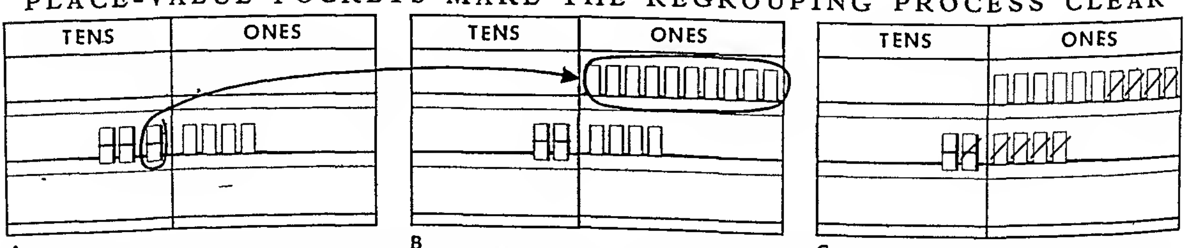
In A, we subtract 28 from 30 to find the remainder, 2. In B, we subtract 168 from 182 to find the remainder, 14. Many incorrect answers in division are due to errors in subtraction. Skill in subtraction is necessary for successful work in division.

The method of subtracting decimal fractions is similar to the method of subtracting whole numbers, as is shown in the example at the left. The chief point to remember is to be sure to place the decimal point correctly in the answer.

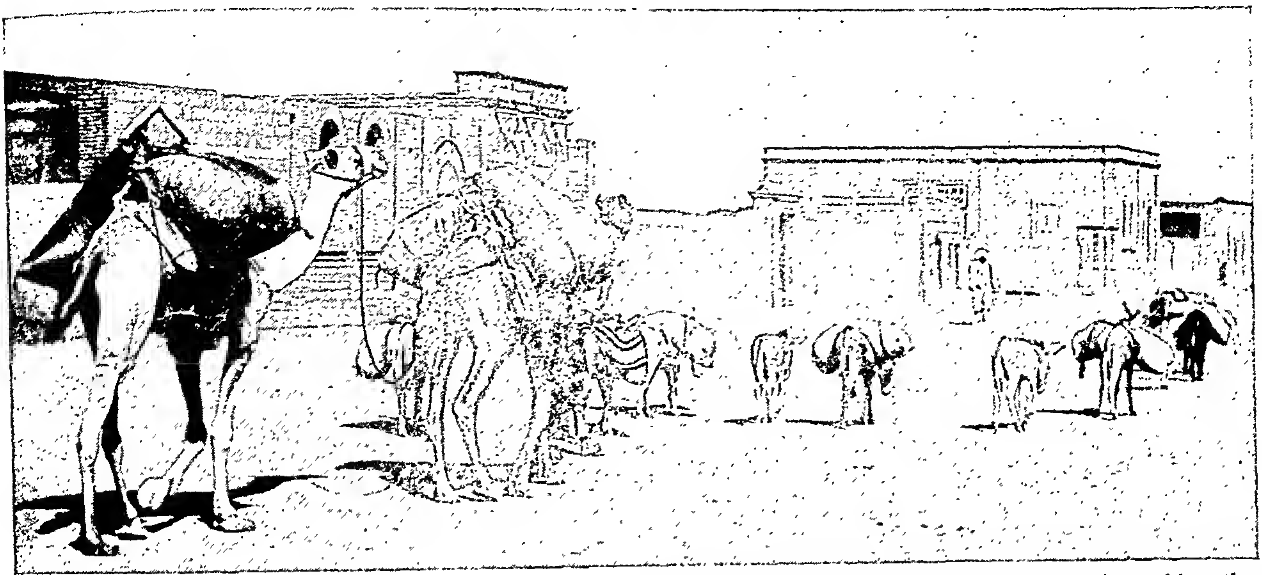
$$\begin{array}{r} 3.4 \\ -2.1 \\ \hline 1.3 \end{array}$$

In school, children also learn how to find the answers to subtraction examples involving fractions. (*See also* Arithmetic; Number System; Addition; Multiplication; Division; Fractions; Decimals.)

PLACE-VALUE POCKETS MAKE THE REGROUPING PROCESS CLEAR

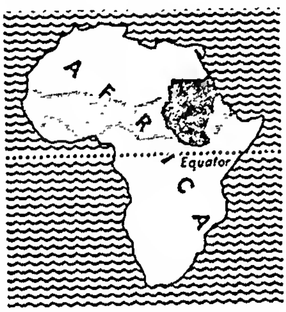


The subtraction example is 34−18. Pocket A shows 34 as 3 tens and 4 ones. B shows how to regroup 34 as 2 tens and 14 ones. In C the crossed-out cards (1 ten and 8 ones) are the number subtracted. (In the classroom, where real pockets and cards are used, these would be taken away.) The cards not crossed out in C (1 ten and 6 ones) are the answer to the example, *16*.



A caravan of camels and donkeys is led through an old section in the city of Khartoum, capital of the Sudan. In this land of glaring heat, the houses have walls of thick brick for coolness.

SUDAN. The great grasslands (savanna) of northern Africa are called the Sudan. The Sudan is a land that divides the equatorial rain forests in the south and the arid wastes of the Sahara in the north.



On the northern edges of the equatorial forests the heavy rains begin to diminish and the rainy season is shorter. Tall grasses begin to appear among the trees. Gradually the trees disappear almost completely and vast subtropical grasslands stretch for many miles northward toward the Sahara.

As the grasses approach the desert they grow shorter and shorter until they vanish in the sands of the Sahara (*see* Grasslands). The grassland belt stretches from the Atlantic in the west to Ethiopia and the Red Sea in the east (for maps, *see* Africa).

Sudan is an Arab word meaning "black." The Arabs called this region the land of the blacks because of the many Negro tribes they found living there. Many of these tribes, particularly in the north, have mingled with Hamites and Semites. Most of them are Moslems. (*See also* Africa; Races of Mankind.)

The word Sudan is used to mean different things. In one sense it means the entire belt of grassland from the Atlantic to the Red Sea. Most of the western and central parts of the Sudan, in this sense, are administered by France. These include the territories of French Sudan and Niger, in French West Africa; and Tchad, in French Equatorial Africa.

The most important part of the Sudan is in the east. It used to be called the Anglo-Egyptian Sudan because it was ruled jointly by Great Britain and Egypt. Joint rule ended in 1953 when Britain and Egypt agreed to allow the Sudanese to decide in 1956 if they want to be an independent nation. Until 1956 the Egyptian and British governments were to cooperate in the constitutional development of the Sudan, and the governor general was to be retained. A parliament was elected by popular vote.

The Land and the Climate

The Sudan (former Anglo-Egyptian Sudan) is bordered on the north by Egypt; on the west by French Equatorial Africa; on the south by the Belgian Congo, Uganda, and Kenya; on the east by Ethiopia, Eritrea, and the Red Sea. It has an area of 967,500 square miles.

The waters of the Nile bring life to the dry Sudan as they do to Egypt. The river has two main branches —the White Nile and the Blue Nile. The Blue Nile rises in the highlands of Ethiopia and flows northwest into the Sudan. The White Nile flows out of Lake Victoria in the East African plateau and flows north. The branches meet at Khartoum, capital of the Sudan, and continue as one stream north into and through Egypt, finally emptying into the Mediterranean. (*See also* Nile River.)

The northern Sudan (ancient Nubia) is mostly desert, with almost no rain. Except for the Nile Valley, an oasis is hard to find. The arid wastes of the Libyan Desert stretch westward from the Nile and on into the Sahara. The Nubian Desert extends eastward from the river to the Red Sea hills. These hills are the only prominent highlands in the Sudan.

The southern, and greater, part of the Sudan is in the grassland belt. Rainfall increases as the grasslands approach the equator. There are forests along the banks of the White and the Blue Nile.

The Sudanese People

The peoples who live in the north have for centuries been under Moslem influence. They have intermarried with Hamites and Semites and thereby developed a culture unique in Negro Africa. They dress like Arabs, with turbans and robes of flowing homespun.

DINKA TRIBESMEN FISHING
The Dinka of the southern Sudan raise cattle for a living. They also fish in large groups to add to their food supply.

A typical tribe is the Hadendowa (or Fuzzy-Wuzzies) of the Nubian Desert and Red Sea hill region. The northern tribes are nomadic or seminomadic camel and cattle herders. They live mostly in tents. (For picture in color, *see* Africa; *see also* Nomads.)

The southern tribes are different. Their culture is one of the most primitive in Africa. Until recent years they had almost no contact with the outside world except for slave raiders from the north. They wear little or no clothing and live in baked mud huts. They travel the rivers and streams in crude dugouts. They raise cattle and are great fishermen. Among the largest southern tribes are the Dinka and Nuba (for picture, *see* Africa). The Nuba are athletes; they particularly like a rough form of wrestling. There are also seminomadic Arab tribes who have camels and flocks of sheep. The population of the Sudan in 1949 was estimated at 8,309,663.

Resources and Trade

The Sudan is the world's chief source of gum arabic, which comes from the acacia tree. The principal grain crop is millet, the staple food of the Sudanese. The Blue Nile has been dammed at Sennar and irrigates about one million acres. There cotton is produced for export. The forests of the Blue Nile are rich in fiber and tanning materials. The forests of the White Nile yield ebony and bamboo.

Other products are senna leaves and pods, dates, sesame, peanuts, hides and skins, and salt. Except for salt, the Sudan is poor in minerals. There are small deposits of gold, iron, lignite, and copper.

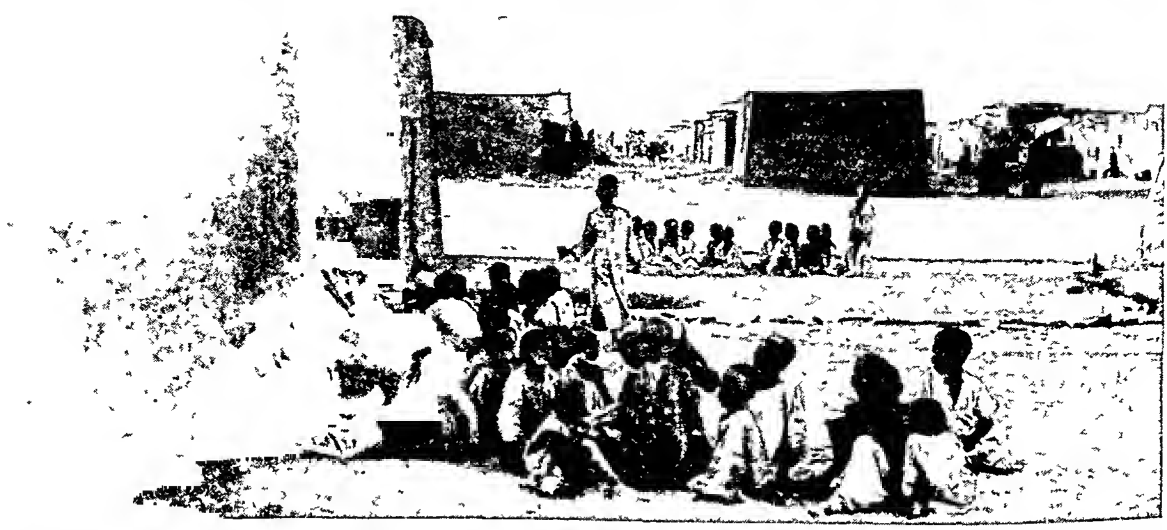
The principal imports are cotton piece goods, sugar, coffee, tea, petroleum products, motor vehicles, machinery, and various metals. The most important exports are cotton, gum arabic, and cottonseed.

Transportation and Communication

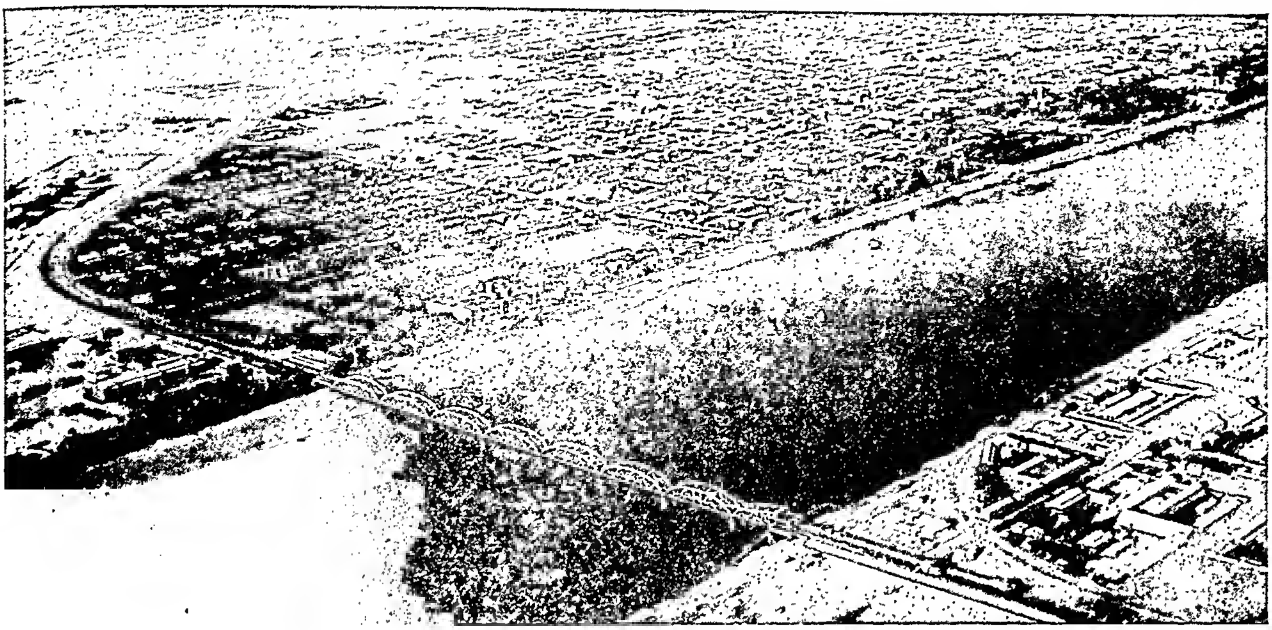
Most transportation is state controlled. The Nile and its tributaries are still important, particularly in the southern Sudan where steamer services are connected by bus with the transportation systems of Kenya, Uganda, and the Belgian Congo. Railroads run from Khartoum to Port Sudan on the Red Sea and Wadi Halfa on the Egyptian border. There is an international airport at Khartoum served by British Overseas Airways and Air France. Emergency landing strips have been built in the desert (for picture, *see* Africa). The radio stations at Khartoum and Omdurman broadcast their programs in Arabic.

History

The southern Sudan had no early recorded history. The northern Sudan was known to the ancient Egyp-



SUDANESE CHILDREN AT SCHOOL
These children are having their classes in the shade of the schoolhouse wall. The school is in a native quarter of Khartoum. Note how the baked mud houses in this hot, dry climate resemble the adobe houses of the southwestern United States.



SUDAN'S CAPITAL ON THE NILE
Khartoum was built where the White Nile and the Blue Nile meet. The bridge crosses the White Nile to Omdurman.

tians as Nubia. The Nubians lived in the Nile Valley between Egypt and Ethiopia. They paid tribute in gold and slaves to the Egyptians (*see* Egypt, Ancient). The Nubians were converted to Coptic Christianity in the 6th century. In the 15th century Nubia was conquered by Arabs who introduced Mohammedanism. Arabs and Negroes intermarried. Moslem influence became dominant. Only traces of the Coptic church remained.

In the 19th century Egypt was under Turkish rule. The viceroy, Mehemet (Mohammed) Ali, invaded the Sudan about 1819 and took control of the country. He founded the city of Khartoum. The Egyptian government used the Sudan as a dumping ground for undesirable officials. Taxes were high and there was corruption throughout the government.

In the 1800's Egypt had become virtually a British dependency as a result of dealings over the Suez Canal (*see* Egypt; Suez Canal). As a result, the Egyptian garrisons in the Sudan had British military advisers, including Gen. Charles Gordon.

In 1882 Mohammed Ahmed, the son of a Dongola boatbuilder, proclaimed himself the Mahdi (the Moslems believed that a Messiah called the Mahdi would appear to lead them in the last days of the world). A religious revolt swept the Sudan. General Gordon was sent to bring home the Egyptian garrisons and abandon the Sudan. He was besieged in Khartoum. The Mahdists overwhelmed the Egyptian and British forces and Gordon was killed. (*See also* Gordon.)

Gordon's death and the fall of Khartoum led to the surrender of forts farther up the Nile. The Mahdist victory was complete. After the death of the Mahdi in 1885 his successor, the Khalifa, held the Sudan under tyrannical rule for 13 years. At the battle of Omdurman in 1898 the Khalifa was overthrown by a combined British and Egyptian army under the command of General Kitchener (*see* Kitchener).

In 1899 Egypt and Britain agreed to govern the Sudan as a condominium—the two governments to rule jointly. Until 1953 the official name of the Sudan was the Anglo-Egyptian Sudan. A governor general was appointed by the Khedive of Egypt (formerly the viceroy) on the recommendation of the British government in London. Egyptian laws were not to apply to the Sudan unless by direction of the governor general. There was to be free trade between the Sudan and Egypt. The slave trade was prohibited.

Egypt became independent of Britain in 1922 and began to demand undivided control of the Sudan. However, a treaty of alliance, signed in 1936, continued to recognize Britain as joint ruler of the Sudan. In 1953 Britain and Egypt agreed to allow the Sudanese to decide in three years if they wanted an independent state.

SUEZ (*sṳ-ĕz′*) **CANAL.** The dream of a canal across the Isthmus of Suez had occupied the minds of men from the time, centuries ago, when the pharaohs of Egypt had connected the Nile with the Red Sea. Nothing came of the dream. Ships continued to sail or steam all the way around Africa in order to reach the Mediterranean from the Red Sea. Then in 1858 a French engineer, Ferdinand de Lesseps, acquired the right from his friend, Said Pasha, viceroy of Egypt, to organize a company and begin the work.

On Nov. 17, 1869, the "ditch in the sands" was formally opened. There were elaborate and costly ceremonies at the northern terminus, Port Said, which is named for Said Pasha. Afterward a fleet of vessels of various nationalities steamed through the canal toward the city of Suez at its southern end. The leading vessel, the French Imperial yacht *Aigle,* carried Empress Eugénie, wife of Napoleon III. At Ismailia, the midway port, Khedive Ismail Pasha entertained some 6,000 persons in his new and expensive palace.

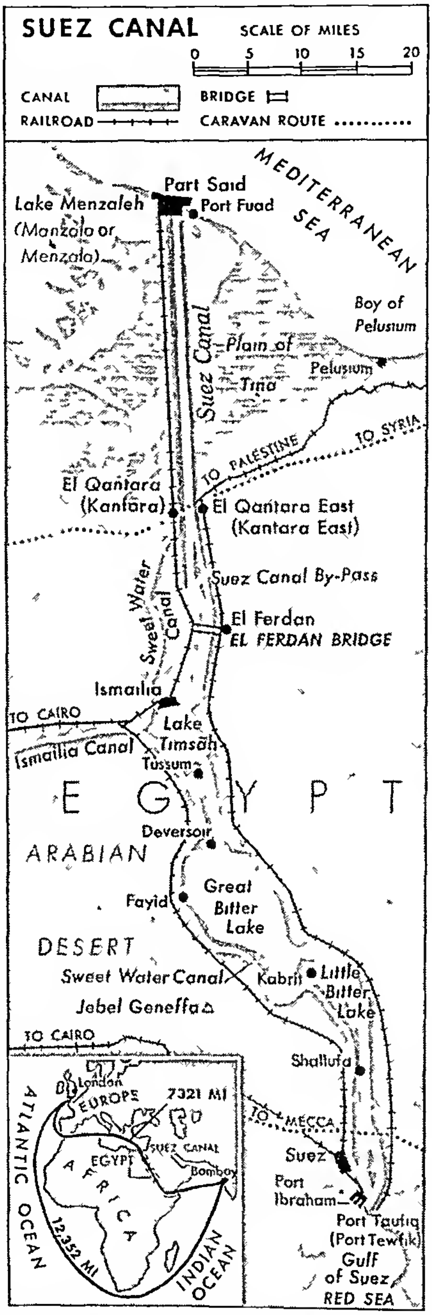
Although about a hundred miles long, or twice as long as the Panama Canal, the Suez was easy to dig except for a 50-foot ridge north of Lake Timsah. It crosses flat terrain at sea level without locks.

The company found it difficult to finance the canal, which cost about 70 million dollars. When De Lesseps was organizing the project, Britain, Russia, Austria, and the United States would not subscribe. Britain feared that the canal would endanger its shipping and its possessions in Asia. But when the bankrupt Khedive of Egypt sold his 176,602 shares (of a total of 400,000) the British government bought them in 1875. This was one of Prime Minister Disraeli's boldest acts to promote his policy of imperialism (*see* Disraeli). These British shares, purchased for about 20 million dollars, have since earned many times that amount. British shipping has benefited greatly from the canal.

A 99-year concession provided that the canal would revert to Egypt in 1968. The Suez Company was a private Egyptian corporation with offices in Paris. Of the present 800,000 shares, French citizens (not the French government) held 52 per cent; the British government, 44 per cent. Shareholders had one vote for each 25 shares, with a limit of ten votes. On the board, the French were greatest in number. The other members were British, Egyptian, Dutch, and an American.

The vision of De Lesseps has been fulfilled. The trip of 12,352 miles from London to Bombay around the Cape of Good Hope was shortened to 7,321. Between the two World Wars an average of 5,000 ships carrying 28 million net tons a year passed through the canal. After World War II traffic increased to a peak of about 12,000 ships and some 90 million net tons, chiefly petroleum. Only the Sault Ste. Marie canals carry more tonnage. The Suez handles more than twice as much tonnage as does the Panama Canal. British ships lead in use of the Suez. Also numerous on the canal are ships of Norway, France, Panama, the United States, Italy, and the Netherlands.

SHORT CUT BETWEEN THE SEAS



The canal saves 5,000 miles between London and Bombay. It uses lakes and in part follows ancient canals, one dug by the Egyptians about 1350 B.C. Along the Suez run a railroad and a canal for drinking water.

Two convoys each way daily cross Suez in about 14 hours under their own power. Moving ships may pass each other in the lakes but not in the canal. Searchlights on ships permit travel at night. Dangerous cargo and mail have priority. In 1949 the company began enlarging harbors and deepening the canals for ships of 36-foot draft. The seven-mile Suez Canal By-Pass, completed in 1951, speeds up traffic by allowing convoys to pass each other.

By the Convention of Constantinople of 1888, the canal is an international waterway open to all nations in peace or war. Russia's fleet in 1905 went through the canal to engage the Japanese in the Pacific. In World War I, German submarines in the Mediterranean prevented use of the canal, and Turkish troops unsuccessfully attacked it. In 1935 Italy used it for the Ethiopian invasion. During World War II, German and Italian airplanes interrupted navigation with mines and bombs.

After World War II, even though Egypt had been given a greater share in operating the canal, there were riots and armed clashes between Egyptians and British. Egypt blockaded Israel-bound ships in 1948 and refused to comply when the United Nations in 1951 condemned its actions.

In June 1954, Britain and Egypt agreed that all British troops would be withdrawn from Egypt within 20 months. If, however, an armed attack were made on Egypt, on any other member of the Arab League, or on Turkey, British troops would be sent to help defend the canal zone. (*See also* Egypt; Canals table in the Fact-Index.)

Suffrage. "Who shall be allowed to vote?" is one of the most important questions when drawing up the constitution of any self-governing body. This is true whether the organization is a fraternal society, a city or state government, or a league of nations. This privilege of voting is known as *suffrage*.

Until recent years political suffrage was restricted in most countries to men over 21. Other requirements are usually citizenship and a certain term of residence where one votes. In the United States the states grant and control the suffrage, so requirements for the suffrage vary greatly. The idea that voting is a "natural right" of man has a logical conclusion in universal

adult suffrage, but in most of the United States the suffrage is restricted by the exclusion of criminals, idiots, illiterates, and sometimes other classes. A property qualification is now seldom required. Woman suffrage—the right of women to vote on the same or almost the same terms as men—spread rapidly in the 20th century, both in the Old World and the New. In 1920 the principle was embodied in the United States Constitution by the 19th amendment (*see* Women's Rights).

Previous to the Civil War most of the states withheld the right to vote from Negroes. By the 15th amendment to the Constitution, the states are forbidden to abridge suffrage "on account of race, color, or previous condition of servitude." Today about 60 per cent of American citizens are eligible to vote, but even in presidential elections only 50 to 70 per cent of the vote has been cast. There has been some agitation to make the vote compulsory, as has been tried in Belgium, the Netherlands, Argentina, and elsewhere, but no such action has ever been taken. There also is a persistent movement to permit the public, instead of the state legislatures, to vote on amendments to the Federal constitution. (*See* Elections.)

Sparkling, White SUGAR *from* CANE *and* BEETS

SUGAR. A liking for sweet things seems natural to human beings everywhere. In ancient times people satisfied their desire for sweets with honey. Today sugar is the most widely used sweetening. The amount of sugar used in the United States has increased steadily, except in war years, since colonial days. Americans consume every year about the equivalent of a hundred-pound bag of sugar apiece.

Of all foods, sugar is probably the most widely distributed in nature because it is made in the leaves of all green plants by photosynthesis (*see* Plant Life). Some of the sugar formed by plants is needed for their own growth and development. Some of it is changed into starch, fat, protein, and vitamins. The cellulose of wood, the oil of a peanut, even the color and fragrance of a flower, are derived from sugars which plants make in their leaves.

Sugar can be extracted in usable quantity from a great number of plants. Grapes, watermelons, sugar maples, and palms are a few of these. The sugar cane and sugar beet, however, produce sugar more abundantly than other plants. For that reason they are the main sources of commercial sugar.

On a Hawaiian sugar plantation workers harvest the ripened cane with long, heavy knives. Sugar cane is a gigantic plume-topped grass. It is planted so closely that a cane field looks like a green jungle.

The sugar cane is a giant grass which thrives in a warm, moist climate. It stores sugar in its stalk. The sugar beet grows best in a temperate climate. Its sugar is stored in a tapering, white root. Beet and cane sugar are identical products, which chemists call *sucrose*. Table sugar is 99.9 per cent pure, and it reaches us in the same chemical form as nature made it in the plant.

Sugar from Sugar Cane

Unlike most crops, sugar cane is not grown from seed but from sections of the stalk, each containing an "eye" or bud. These sections are placed end to end in furrows. A week or more after planting, the first sprouts appear above ground. During the course of the growing season, which may range from nine months to two years, the cane shoots up 15 feet or more, and the stalks are so closely spaced that the fields resemble a jungle.

At harvest time the cane is cut off near the ground. Harvesters usually work with long heavy knives, but

in some areas, machines are used. The stalks are stripped of their leaves and chopped into short lengths so that they can be handled easily. The sugar cane is loaded into carts, trucks, or railroad cars and taken to the plantation's own raw-sugar mill.

In the mill the stalks are carried to crushing rolls which shred the cane by twisting it as it passes through. This separates the fibers and prepares them for grinding but does not press out the juice. The shredded cane is fed through a series of heavy steel rollers which revolve against each other under great pressure. This action forces out the juice which is caught in pans below the rollers. At the end of this operation the cane fiber, or *bagasse*, is so dry that it can be used to fire the mill furnaces which heat the sugar boilers.

SUGAR CANE FOR PLANTING

Sugar cane is not grown from seed but from short pieces of stalk which contain a bud. This plantation worker is carrying a load of such pieces to the field for planting.

The cane juice is then changed to raw sugar. The juice is treated in a number of ways to remove impurities. Then it is boiled until it thickens and crystals form in it. This mixture of molasses and crystals (called *massecuite*) is whirled at high speed in a centrifuge, a circular basket of metal screening. The syrup, known as blackstrap molasses, is thrown off and the sugar is retained.

Raw sugar is light brown and slightly sticky because the crystals have a thin film of molasses clinging to them. Further refining is necessary to produce a clear, white sugar. Some raw sugar is refined in the tropics, but most of it is shipped to refineries in the United States and other sugar-consuming countries.

The refining of sugar consists of three major steps:

First, the raw sugar is treated to remove molasses and the resulting crystals are then dissolved in warm water.

Second, the syrup is filtered a number of times to remove impurities and color.

Third, the sugar is recrystallized by boiling in vacuum pans, washed again and dried, and then packed in bags and cartons.

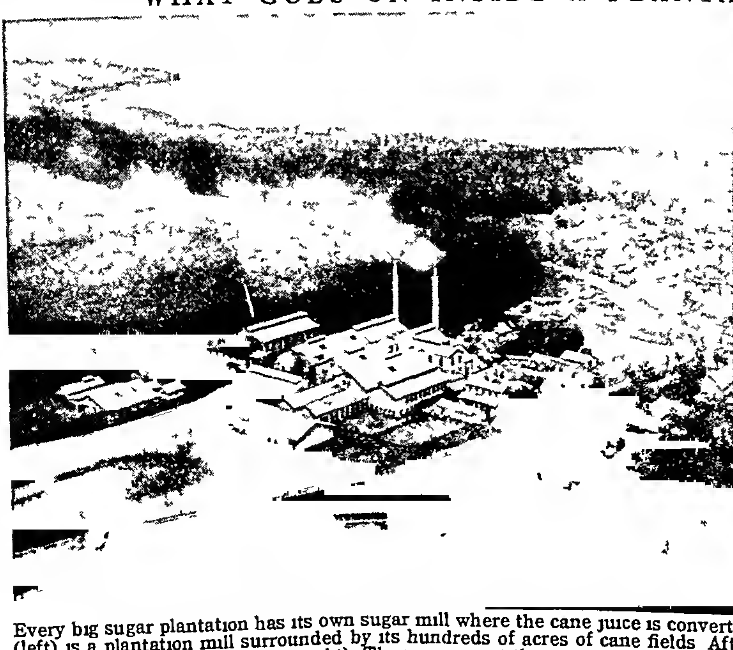
Sugar from Sugar Beets

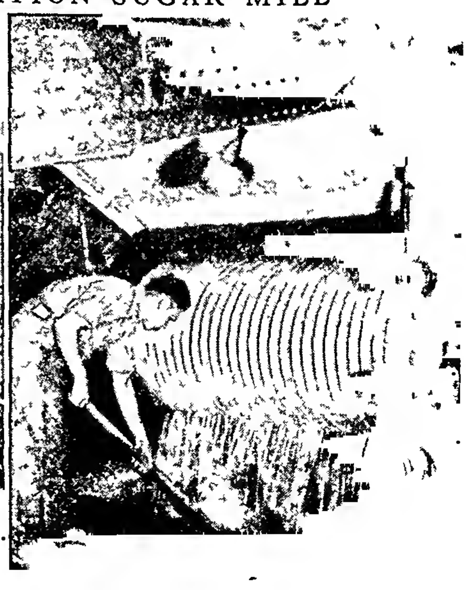
The other source of our sugar is the sugar beet, which grows in many parts of the United States. The average sugar beet weighs about two pounds and stores 14 teaspoons of sugar in its root.

Beets, like cane, are thirsty plants. A single beet may take up as much as 15 gallons of water in a growing season. Beet fields in the arid sections of the West must be irrigated. Water is brought to the land from mountain streams and held in reservoirs until it is needed.

The growing season of the beet is about seven months. When the crop is mature, the beets are lifted from the soil and their leafy tops are cut off to be used as cattle feed. The beets are then hauled to nearby factories, where they are piled in huge stacks until they can be processed.

WHAT GOES ON INSIDE A PLANTATION SUGAR MILL



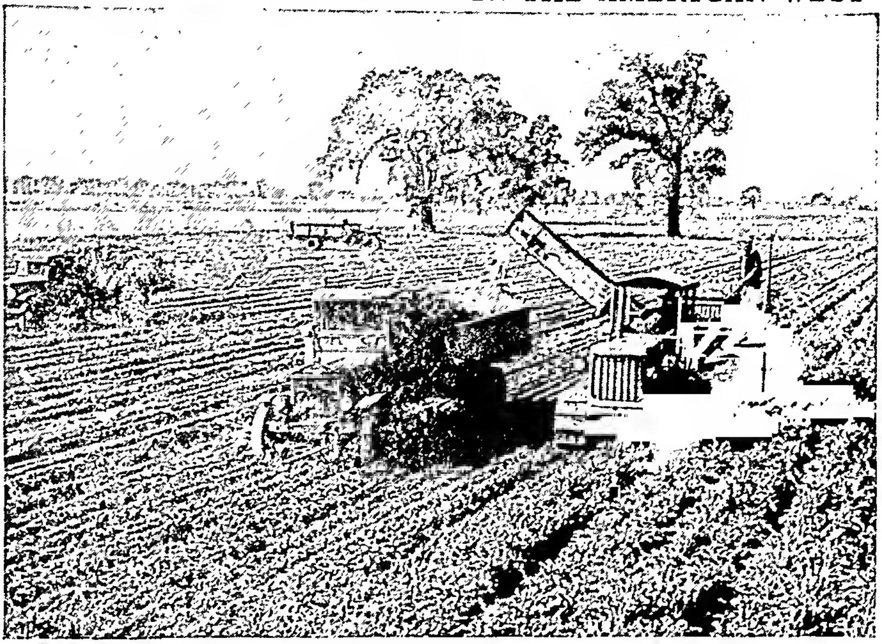


Every big sugar plantation has its own sugar mill where the cane juice is converted into sticky brown raw sugar for shipment. Here (left) is a plantation mill surrounded by its hundreds of acres of cane fields. After the cane has been shredded, it is run through a series of rollers (right). These press out the sweet watery juice which is boiled down into raw sugar.

The beets are carried into the factory on moving belts or in troughlike flumes with running water. When they have been thoroughly washed, machines slice them into strips about the size and shape of "shoe-string" potatoes. These *cossettes*, as they are called, are placed in large tanks and treated with hot water to soak the sugar from them.

The sugar-laden juice is purified, filtered, and concentrated through a series of processes. These differ in detail from those of a cane-sugar refinery, but give the same result—a clear, white, sparkling sugar. One difference is that processing is a single operation in the United States. There is no raw sugar. Beets go in one end of the factory and granulated white sugar comes out of the other. When the sugar is finally crystallized, it is dried, screened, weighed, and put in sealed packages for the market.

HARVESTING SUGAR BEETS IN THE AMERICAN WEST



Sugar beets are grown in rows much as any other root crop. In dry country, trenches are left between rows for irrigation. Here the ripe beets are being harvested by machinery. Sugar beets have very deep roots and so are hard to pull by hand.

Special Kinds of Sugar

Sugar is prepared for market in other ways as well. Powdered, or confectioner's, sugar is made by grinding the best grades of granulated sugar and sifting the powder through silk bolting cloth. Brown sugar is prepared by boiling cane syrup in such a way that very small crystals are formed. A certain amount of molasses is allowed to remain, giving the sugar its brown color and caramel flavor.

Cube sugar is made in two ways. Wet granulated sugar is often compressed in little molds the size of sugar lumps. It is also made by running sugar from the vacuum pans into molds which form slabs half an inch thick. These are dried and sawed into cubes.

Before the days of modern sugar refining, sugar was sold in loaves. The partly crystallized syrup was poured into conical molds about 18 inches high. The molasses drained through a hole in the tip of the cone, leaving the crystals, which dried into a hard mass. These conical sugar loaves were wrapped in blue paper for market. Sometimes the loaves were sawed and sold as "cut-loaf" sugar.

TOPPING A SUGAR BEET

Leaves of sugar beets are often cut by hand, though machinery is sometimes used. This picture gives an idea of the size of a sugar beet.

Sugar's Long History

The wild sugar cane was first cultivated many centuries before the time of Christ, probably in India. Its culture spread through the Eastern world but did not reach Europe until the Middle Ages when conquering Arabs brought it to Spain. The word *sugar* is Arabic in origin. Columbus carried the plant to the West Indies where it thrived in the favorable climate and soil. For many years sugar was an expensive luxury. Queen Elizabeth I served sugar at her table, but it was used chiefly in medicines. By the end of the 17th century production in England's West Indian "sugar islands" had greatly increased and sugar came into common use in London coffeehouses.

Cane culture began in what is now the United States in the middle of the 18th century when cuttings were planted at New Orleans. The first American sugar refinery was built in New York City in 1689. After the Revolution refining made steady headway. The industry was thoroughly established by the 1830's, when the first attempts were made to produce beet sugar in the United States.

The beet-sugar industry had its beginnings in Europe. In 1747 Andreas Marggraf discovered sugar in the wild sugar beet, and 40 years later one of his students, Franz Karl Achard, succeeded in extracting sugar from sugar beets. Beet sugar was produced commercially in 1802 at Cunern, Silesia, under the encouragement of Frederick William III of Prussia. During the Napoleonic Wars, when France was blockaded by the

Allies, Napoleon made huge grants of land and money to establish the beet-sugar industry. With that start, the industry grew rapidly and spread to other countries on the continent.

Early attempts to establish the industry in the United States were disheartening. From 1838, when the first factory was built, one after another failed. Finally in 1872 a factory at Alvarado, Calif., demonstrated that it could produce sugar profitably. By the end of the century 30 factories were in operation.

The Sugar Industry Today

Each year the world produces some 35 million tons of sugar and the United States uses about one fifth of the total. Only a small amount is consumed as table sugar. Great quantities are used in baked goods and in soft drinks. The food industries also use sugar in cured meats, candy, frozen and canned fruits, cereals, ice cream, and other products. It enters also into the manufacture of such diverse products as cosmetics, plastics, and shoe polish.

The principal cane-producing areas of the world are Cuba, India, Brazil, Puerto Rico, Hawaii, the Philippine Islands, Australia, and Argentina. In the continental United States substantial quantities of cane are grown in Louisiana and Florida. Cane is also grown in other Southern states, but it is used largely for making syrup rather than sugar.

Principal beet-growing countries are the United States, Russia, Germany, France, Poland, Italy, Czechoslovakia, and Great Britain. In the United States beets are grown in more than 20 states from the Great Lakes to California. Leading states are California, Colorado, and Idaho.

Both the sugar cane and the sugar beet have important and industrially useful by-products. These are mainly bagasse, from sugar cane; beet pulp, from sugar beets; and molasses, from both plants.

Bagasse is used largely as a fuel for sugar-mill boilers, but some of it is baled and shipped to factories. There it is pressed into wallboard, and in some areas, used as a source of fiber for paper.

Beet pulp, which remains after the extraction of sugar, is a rich carbohydrate material. It is used extensively as a cattle feed, either wet or dry. Even in areas where beets are not grown, dried beet pulp is shipped in as a feed for dairy cows. It is also used in the production of yeast and citric acid.

Molasses from cane may be refined and used as a table and kitchen sweetening, but beet molasses cannot be so used because of its bad taste. Blackstrap and beet molasses are important sources of industrial alcohol, which enters into the production of many other substances. They also yield acetone and butanol, solvents used in making plastics, and other industrial products. Citric, lactic, and gluconic acids are made from molasses, as well as such pharmaceutical products as histadine, histamine, and vitamin B_2.

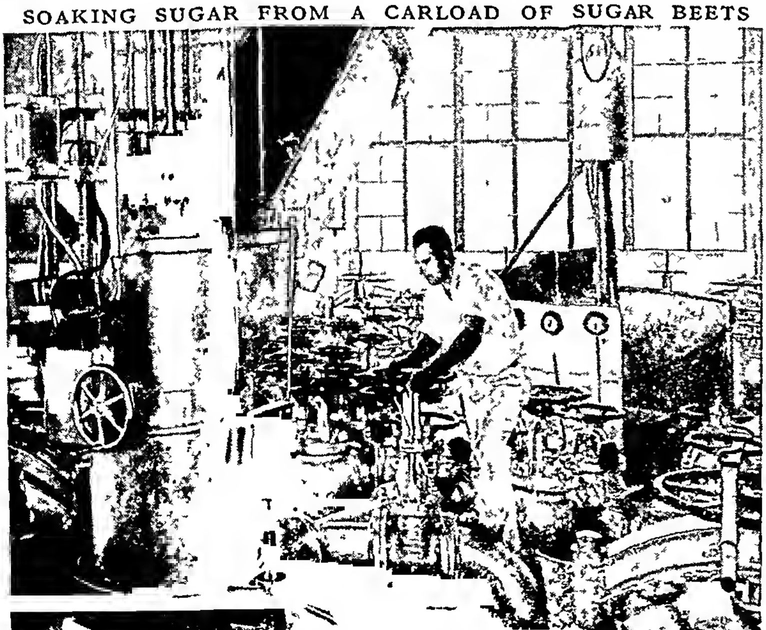
Chemistry of Sugar

Table sugar (cane or beet) is the most familiar of many substances called sugars. They are all composed of carbon, hydrogen, and oxygen. The last two are present in proportion of two to one, as in water (H_2O)—hence the name *carbohydrate*. Sugars are identified in chemistry by names ending in *-ose*. The common sugars fall into two classes: the *monosaccharides* and the *disaccharides* ("single" and "double" sugars). The disaccharide molecule is capable of splitting up into two monosaccharide molecules.

Ordinary table sugar (*sucrose*) is a disaccharide ($C_{12}H_{22}O_{11}$). So also are *maltose* and *lactose*. They have the same chemical formula as sucrose, but the atoms are arranged differently in their molecules. Maltose is formed from starch by the action of malting (*see* Malt). Lactose, or milk sugar, occurs in milk and some other animal fluids; it is the foundation of many pills. Maple sugar, jaggery (palm sugar), and sorghum sugar are all chemically sucrose.

Monosaccharides have only one carbon atom to each H_2O unit. The most common monosaccharides are *glucose* and *fructose*. Both have the formula $C_6H_{12}O_6$. Glucose, or grape sugar, is found in raisins and in many plants. Fructose, or fruit sugar, may be used as a substitute for cane or beet sugar in the diet of diabetic patients. Commercially, the name glucose is given to corn syrup, because the syrup owes its sweetness principally to glucose (*see* Glucose). *Xylose*, or wood sugar, is a five-carbon monosaccharide. It is used in tanning and dyeing and in special diets for diabetics.

SOAKING SUGAR FROM A CARLOAD OF SUGAR BEETS



In a beet-sugar factory the beets are sliced into thin strips and set to soak in big tanks. Juice from these diffusion tanks will be piped to other parts of the factory for boiling, purifying, and drying.

Related to the common sugars are rare sugars classified as *trisaccharides* and *tetrasaccharides*. Starches and cellulose (*polysaccharides*) are not sugars but are related members of the carbohydrate group. The same is true of gums, mucilages, and tannins, which are saccharides whose molecules are joined with those of other compounds.

Sugar in Cooking

When sucrose is heated with a little water until it melts and begins to turn yellow, it forms on cooling a hard glassy mass called *barley sugar*. If heated still more it partially decomposes, leaving a soluble brown material called *caramel*, which is used to flavor food and to color beverages.

A mixture of glucose and fructose, called *invert sugar*, is found in honey and many sweet fruits. Glucose and fructose are also called *dextrose* and *levulose* because the one rotates polarized light to the right and the other to the left (*see* Light). When table sugar is boiled with water containing a little acid, it breaks down into a mixture of dextrose and levulose. This invert sugar does not crystallize readily. So in making fudge or cake icing we often add a little vinegar or cream of tartar to the sugar, turning some of it to invert sugar.

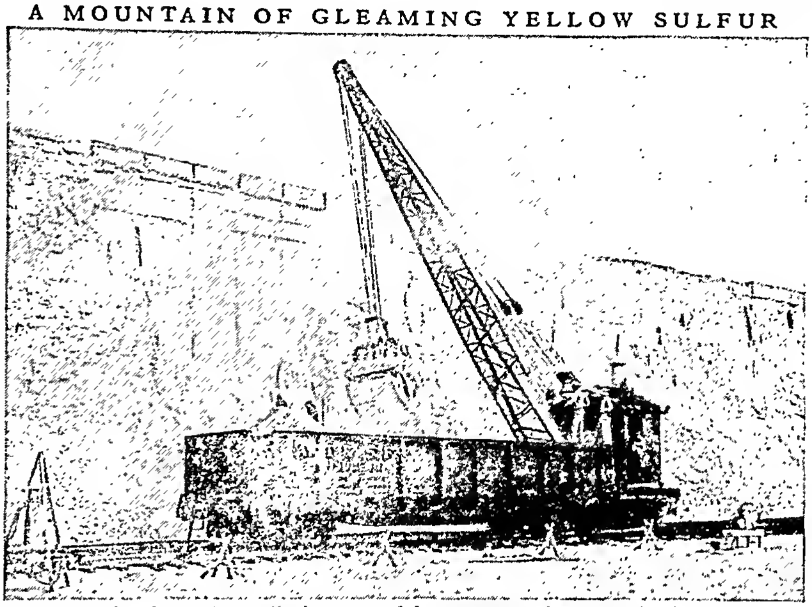
Saccharin is a white powder made from coal tar. It is 400 times sweeter than cane sugar and has little or no food value. For this reason it is used in diabetic and reducing diets. Saccharin also serves as a sugar substitute in the food industry. Sodium cyclohexyl sulfamate (sold under the trade name Sucaryl) has similar properties and withstands cooking better than saccharin.

SULFUR. In any industrial nation, such as the United States, sulfur is one of the most essential raw materials. It is used in thousands of products and processes. Sulfur is a nonmetallic element, bright yellow in color and similar to oxygen in its chemical behavior. In solid form it is relatively hard and about as heavy as brick. Sulfur burns readily with a blue flame, a fact which accounts for its old name *brimstone*, or "burning stone."

Sulfur is one of the elements necessary to life. It is found in many animal and vegetable substances, especially proteins. The bad smell of a rotten egg is due to hydrogen sulfide, and it is the sulfur in eggs that tarnishes silver so quickly, forming the black compound silver sulfide. Cabbage and other members of the mustard family are particularly rich in sulfur, as are such animal substances as hair.

Sulfur and its compounds enter into many familiar products. The fact that sulfur burns (combines with oxygen) so readily accounts for its use in matches, gunpowder, and fireworks. Sulfur candles are sometimes used to kill vermin in old buildings. Bordeaux mixture, a standard insecticide, is partly copper sulfate, and many preparations to prevent fungus diseases contain sulfur. All vulcanized rubber contains sulfur, and sulfur compounds are used in the manufacture of paper.

A MOUNTAIN OF GLEAMING YELLOW SULFUR



Molten sulfur from the wells is pumped into rectangular vats the length of two city blocks. When it has hardened the wooden walls are removed and the huge block of pure sulfur is broken up and loaded in railroad cars for shipping.

The Sulfur Industry

Sulfur exists in nature both in its native, uncombined form and in compounds. A large proportion of the world's native sulfur occurs in the salt domes of the Gulf region of the United States. There are also big volcanic deposits of sulfur in Sicily. The United States is the largest producer of native sulfur in the world and Italy second. The United States has reserves of sulfur that should last for generations despite increasingly heavy use of sulfur in industry.

Sulfur is also extracted commercially from pyrites (*pī-rī'tēz*). This is a mixture of several sulfur compounds, including the mineral pyrite (*pī'rīt*), or iron sulfide. Japan, Spain, and Cyprus work large deposits of pyrites. In the United States, Tennessee is the leading state in production of pyrites.

The huge deposits of native sulfur in Texas and Louisiana are mined by the Frasch process. In Frasch mining a well is drilled to the underground deposit and a six-inch pipe is inserted in the well casing. Inside this is a three-inch pipe and inside the three-inch pipe a one-inch pipe. Superheated water pumped into the big pipe melts and purifies the sulfur at the foot of the well. Compressed air is then forced into the smallest pipe and it pushes the frothy molten sulfur up through the three-inch pipe. At the surface the sulfur is piped to huge vats where it hardens in blocks hundreds of yards long and 50 feet or more high. In the smaller deposits of California, Colorado, Nevada, and Wyoming, conventional mining methods are used.

Sulfur is also recovered commercially from various gases. "Sour" natural gas is too rich in sulfur to

be used in homes and so it is treated to extract the sulfur. Smelter gases and other industrial fumes are also sources of sulfur.

American industry consumes vast quantities of sulfur. About three fourths of this is used in the form of sulfuric acid. The chemical industry is by far the largest consumer. Substantial amounts of sulfur, however, are used in fertilizers and insecticides, and in the paper and paint industries.

Chemistry of Sulfur

Sulfur occurs in several forms, or *allotropes*. Commonest of these is *rhombic* sulfur whose crystals are many-sided (for picture in color, *see* Minerals). *Monoclinic* sulfur has needlelike crystals in the shape of prisms. *Amorphous* sulfur, a white or pale yellow powder, is noncrystalline.

Sulfur undergoes a number of changes when it is heated. It melts to a watery yellow liquid a little above the boiling point of water. This turns brown and thickens until it bursts into flame at about 482°F. If air is excluded, however, the brown, plastic mass becomes thin again and boils at 832°F. The reddish-brown vapor finally turns colorless if heating is continued.

Sulfur shows valences of 2, 4, 6, and −2. This accounts for the many ways it combines with other elements. Some of its important compounds are the *sulfides*, *sulfites*, and *sulfates*. In sulfides, one sulfur atom is combined, as in hydrogen sulfide (H_2S). In the sulfites, one atom of sulfur and three of oxygen form a radical which combines with other elements as a unit. Sodium sulfite ($NaSO_3$) is an example of such compounds. The sulfate radical has four oxygen atoms. Copper sulfate, or blue vitriol ($CuSO_4$), is a common sulfate used as a germicide and as a mordant in dyeing. Sodium thiosulfate is the "hypo" used in photographic darkrooms; ferrous sulfate (green vitriol, or green copperas) is used in wool dyeing, in disinfectants, and in ink manufacture. Still other sulfur compounds are the *oxides*. Sulfur dioxide (SO_2) is the most useful of these, serving as a bleach and as a preservative.

Sulfur is sold in several forms. *Roll sulfur* is packaged in solid rolls or cones. The powdery *flowers of sulfur* is obtained by cooling sulfur vapor, and *lac-sulfur* is precipitated from solution.

SULFURIC ACID. Few chemicals affect our lives as broadly as sulfuric acid. It is often said that the technical development of a nation can be estimated by its consumption of sulfuric acid. The acid itself rarely comes to our attention, but it helps to create thousands of products for our use.

Sulfuric acid is a colorless liquid. It has an oily consistency, especially in concentrated form, and looks like a clear, rather heavy, syrup. This appearance explains its old name, *oil of vitriol*. Unlike real oils, however, it is violently corrosive. It chars wood, paper, and cloth, eats into flesh, and dissolves aluminum, zinc, and other metals.

Two general properties account for most of its violence. It has a strong affinity for water. Where water is held in a solid substance or in the air, sulfuric acid pulls the water molecules into solution with itself and so dries out the substance. One type of laboratory drier uses a container of sulfuric acid to keep chemicals free of moisture. Sulfuric acid (H_2SO_4) also ionizes readily (*see* Ions). In solution the hydrogen and the sulfate (SO_4) radical separate, leaving the sulfate ion free to attach itself to other atoms. Thus when a lump of zinc is dropped into sulfuric acid, zinc sulfate is formed and the hydrogen which is freed bubbles off as a gas.

The violent chemical behavior of sulfuric acid makes it an extremely useful industrial chemical. Though widely used, however, it seldom appears in a finished product itself. Its biggest single use is in making the fertilizer superphosphate from phosphate rock. The petroleum industry uses it as a catalyst and refining agent. In the dye industry it serves as a sulfonating agent, making dye substances soluble. It is widely employed as an electrolyte in storage batteries and in electroplating baths and is used for cleansing metals of oil and grease. The textile industry employs it in dyeing, bleaching, and mercerizing fabrics. It figures also in the manufacture of such diverse products as soap, leather, glue, and gelatin, and as an etching agent in the lithographer's and photoengraver's trades.

Manufacture of Sulfuric Acid

Sulfuric acid is known by various names in industry. The old name, oil of vitriol, is now applied only to the commercial grade of concentrated sulfuric acid. *Chamber acid,* named from the lead chambers in which it is made, is an impure solution of 60 to 70 per cent of H_2SO_4 in water. It is used mainly in the manufacture of fertilizers. *Oleum*, or *fuming sulfuric acid,* is a solution of hydrogen trioxide (SO_3) in concentrated sulfuric acid. This is the most violent form of the acid.

Sulfuric acid, discovered by the Arabian alchemists, has been manufactured commercially since 1765. The old lead-chamber process is still used, but concentrated and chemically pure grades are made by the contact, or catalytic, process. In the lead-chamber process sulfur dioxide from roasted sulfur is made to react with air, steam, and oxides of nitrogen to form a solution of sulfuric acid. Some of the reactions take place in lead-lined rooms, which give the process its name. In the contact process, platinum or iron oxide is used as a catalyst. It induces sulfur dioxide to unite directly with oxygen from the air to form sulfur trioxide. This is dissolved in previously made acid, and water is added. The water and the trioxide unite to form sulfuric acid; that is, H_2O+SO_3 becomes H_2SO_4.

SUMAC (*shü'măk* or *sū'măk*). During autumn in the northern part of the United States and in southern Canada, some of the most glorious coloring is shown by the staghorn sumac (also spelled *sumach*). This rugged shrub or small tree owes the first part of its name to the resemblance between its crooked branches and a stag's horns. In summer the downy green foliage

makes a fine background for the conelike clusters of hairy, crimson fruit.

Flourishing from Maine west to Minnesota and south to Florida and Texas, the dwarf, or flame-leaf, sumac resembles the staghorn in the autumn coloring of its leaves and fruit. These and several other species are commercially valuable for the tannin they yield.

The most common of several species of poisonous sumacs is the poison, or swamp, sumac. Found in swampy places from New England west to Minnesota and south to Florida and Louisiana, it can be recognized by its drooping clusters of greenish-white fruit.

About 150 species of sumac are native to the temperate and subtropical regions of both hemispheres. The famous lacquer of China and Japan comes from the juice of a cultivated sumac (*see* Lacquer).

The scientific name of the staghorn sumac is *Rhus typhina;* of the dwarf sumac, *Rhus copallina;* of the poison sumac, *Rhus vernix.*

SUMA'TRA. When Batak natives in the wilds of Sumatra decide to hunt down a troublesome tiger, they call in the *guru* or witch doctor. He leads the village in magic ceremonies, which apologize in advance to the tiger for killing it. Then, after the tiger is killed, more ceremonies are performed to appease its spirit. And this may happen not far from modern oil fields, while airplanes fly overhead.

Such a contrast is typical of Sumatra, the world's sixth largest island, in the East Indies. Much of the coast is low, swampy, and untouched by man; dense groves of mangroves shelter only insects, monkeys, and birds. But near this wild coast are some of the world's finest rubber plantations. And the primitive native life in many places contrasts with the high Malay culture around Padang, with its terraced rice fields and colorful villages, topped with the minarets of mosques.

FACTS ABOUT SUMATRA

Extent.—Length, about 1,050 miles; greatest width, about 260 miles. Area, 163,000 square miles. Population (1950 est.), 12,000,000.

Surface Features.—Barisan Mountains with central valley containing Lake Toba, 502 square miles; about 90 volcanic cones, 12 active; highest point, Mount Koerintji, 12,484 feet; chief rivers, Indragiri, Jambi, Musi; chief harbors, Belawan, Benkoelen, Palembang, Sibolga, Teloekbetoeng.

Cities.—Medan (500,000); Palembang (350,000); Padang (150,000). Others, 1930 census: Teloekbetoeng (25,170); Sibolga (10,765); Koetaradja (10,724).

A Mountain Backbone and a Tropical Climate

This island of remarkable contrasts is essentially just one great mountain range, the Barisan Mountains. This range belongs to the uplifted border which runs around Malaya and the East Indies (*see* East Indies). The outer or southwestern edge, toward the Indian Ocean, is steep. The northeastern side slopes gently to the Strait of Malacca and the Java Sea. Only a few of the many rivers have mouths wide and deep enough to serve as harbors.

The climate varies with the seasons, even though Sumatra lies squarely across the Equator, because the *heat* equator moves north and south with the sun. From September through January the northeast monsoon strikes the northeast coast, dropping heavy rain on the mountainsides. Meanwhile the other coast has a dry season. Thereafter each coast has a reversal of season. The rainfall everywhere is at least 60 inches a year; some places have more than 160 inches.

Wild Life in the Equatorial Forest

A thick forest of palms, camphor trees, pepper vines, ebony, and other tropical plants grows from sea level to well up the mountains. It is spotted with orchids and with the huge flowers of the Rafflesia, another parasite, which has blossoms three feet across. The heights have rhododendrons, oaks, and chestnuts. Wherever mountain crests create rain shadows, eucalyptus and bamboo may grow, or the land may be covered with the tall tough grass *alang-alang.*

The forests teem with Asiatic animals such as the elephant, tapir, rhinoceros, Malay bear, and tiger. The hosts of monkeys and apes are headed by the orang-utan. Flying lemurs and flying foxes are seen among the parrots, hornbills, trogons, pheasants, and woodpeckers. Crocodiles infest the river mouths.

Native Ways Still Survive

Unlike its neighbor Java, Sumatra has been touched only slightly by white enterprise, except in the southeast and in patches elsewhere along the coasts.

Many scholars believe that Sumatra was the center from which the mongoloid Malays spread throughout the East Indies, after the 12th century. Today only one small group of true primitives, the Kubus of the middle east coast, show any Negrito blood; the other less advanced peoples, principally the Bataks and the Gayos in the northern mountains, are mixed Malay and Polynesian. Even the most backward among them grow rice and other crops, work in metal, and build fine houses with projecting roofs which keep out the heavy rains.

The coastal Mohammedan Malays have Hindu and Arab blood, particularly the Achinese in the northwest. These people traded as far as Egypt and Japan in the 13th century, and they resisted Dutch rule even in the 20th century. The most advanced Malays live near Padang.

Europeans began to trade with Sumatra early in the 16th century. In 1824 the Dutch got control of Sumatra. In 1863 they developed agriculture, planting fine tobacco near Medan and, later, tea and coffee in the uplands. Rubber was introduced in 1905 and became the chief product. They opened rich oil fields near Palembang and mined some coal and iron. In 1949 Sumatra joined the United States of Indonesia, now the Republic of Indonesia (*see* Indonesia).

SUMNER, CHARLES (1811–1874). For nearly 20 years Charles Sumner, United States senator from Massachusetts, was an outstanding public figure. His antislavery fight stirred the whole nation. He had graduated from Harvard Law School in 1834. After practising law for three years, he went abroad.

On his return Sumner found the practice of law dull. In 1845 he became interested in politics. That year he gave the Fourth of July oration in Boston (where he was born Jan. 6, 1811). In his address he took the extreme stand that "there can be no peace that is not honorable; there can be no war that is not dishonorable." The speech decided Sumner's future. He went on a lecture tour as a determined foe of slavery and soon became one of America's most popular speakers.

In 1848 Sumner ran for election to Congress but was defeated. Two years later he was elected to the Senate as a Free Soil-Democratic coalition candidate and took his seat in 1851. One of his first speeches was an indictment of the Fugitive Slave Law. Later he helped organize the Republican party.

After the Kansas-Nebraska Act was passed by the Senate, Sumner strongly criticized it. In the course of these debates Sumner made a bitter attack upon the South and on Andrew Butler, senator from South Carolina. Two days after the speech, Sumner remained at his desk in the Senate chamber after the others had gone. Congressman Preston Brooks of South Carolina, a relative of Butler, surprised the seated Sumner and brutally beat him with a heavy cane. For nearly four years Sumner was physically unable to resume public life; and he suffered the effects of the attack until his death.

Sumner returned to the Senate just before the start of the Civil War. During this period he opposed any compromise with the supporters of slavery. Emerson declared that for many years Sumner was the "conscience of the Senate," and Lincoln shrewdly characterized him when he said, "Sumner is my idea of a bishop." But sometimes Sumner's grand manner lost supporters to his cause.

During the Civil War he urged the immediate emancipation of the Negro; and he was one of the foremost advocates of granting the vote to the slaves who had been recently freed. His greatest service was as chairman of the Senate committee on foreign relations. His knowledge gained from three years' residence in Europe was of immense help; but he often forgot that the chief direction of foreign affairs was in the hands of President Lincoln and Secretary of State Seward. Sumner was never able to coöperate with Seward.

During the war he ranked with Lincoln as "the two most effective men in public life." But afterward he gradually lost public regard. Although he played a prominent rôle in the Reconstruction, he quarreled constantly with the administration and so lost his effectiveness.

At 55, Sumner married Alice Mason Hooper. They had no children and were separated within a year. Sumner died March 11, 1874.

Our GIANT SUN *and Its* GIANT TASKS

SUN AND SOLAR SYSTEM. The star nearest the earth is the sun. For the sun is really a star, just like the stars we see in the sky at night. And if the sun were not so near, we could see other stars during the day. But just as the sun's brightness blots out other stars from the sight of people on earth, so the sun's importance to the earth makes the other stars of little significance.

As most scientists today agree, the earth itself came from the sun in the beginning, probably about 2 billion years ago. A fiery mass was torn away from the sun, most likely with the aid of a passing star, and whirled out into space. There the sun's force of gravity caught the mass and made it swing around in a great curve, holding it in its path (*orbit*) like a stone on the end of a string. As the fiery earth mass cooled and became solid, the sun kept it lighted and warm (*see* Earth).

Some of the Sun's Great Gifts to the Earth

As the earth cooled, the atmosphere around it would have frozen without heat from the sun; and life could not have started. Without sunlight, no green plants could live and grow (*see* Plant Life). And without plants, animals and men could not have existed. Thus the sun is necessary to living things on our earth. Man himself needs a moderate amount of direct sunlight to maintain good health.

When we burn fuels, we are using the sunlight that was stored up ages ago. Coal and petroleum are the remains of plants and animals buried below the earth's surface. When these plants and animals were alive and growing millions of years ago, they absorbed the energy of sunlight; and they have retained it ever since in chemical storage. When we set fire to their remains, we are releasing this stored-up energy (*see* Coal; Energy; Fuels; Petroleum).

The sun helps provide the rain that plants need for growth. Heat from the sun lifts moisture into the air; and the moisture turns into rain that waters the fields and forests. The same rain renews the rivers that help irrigate dry farming areas and provide the power to run great hydroelectric plants (*see* Rainfall; Water Power). The heat of the sun makes winds; and these also carry moisture to growing things (*see* Winds).

One of the sun's greatest tasks is to keep the earth and the other planets moving in their orbits (*see* Planets). The earth revolves around the sun once a year; and each year brings its regular and welcome change of seasons. As the earth revolves, it also rotates on its axis, making one complete rotation every 24 hours. The daily rotation brings nearly every place on earth toward the sun for some part of the 24 hours; it also turns these same places away from the sun for a period of darkness, or night.

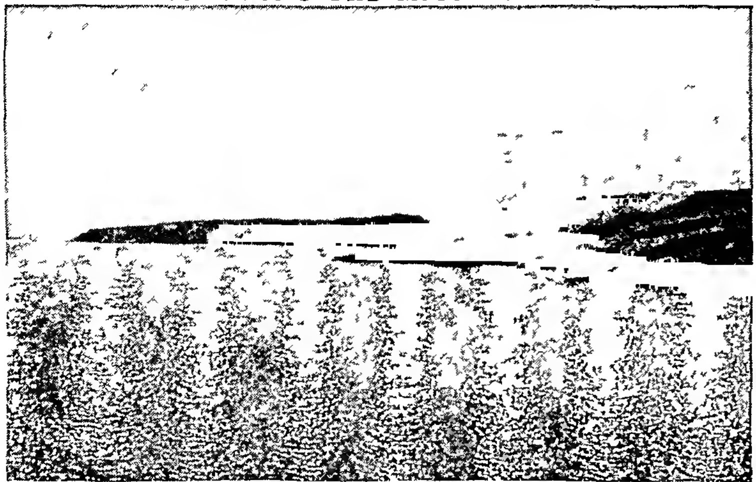
Distance, Size, and Heat of the Sun

The distance of the sun from the earth varies during the year, but it averages about 93 million miles. If a newborn child were placed on a plane flying toward the sun at 150 miles an hour, he would be nearly 71 years

FLAMING STORMS ON THE SUN'S FACE

By using a smoked glass and a small telescope, we can often see black spots on the shining face of the sun. Here the artist shows the nature of the spots, as explained by astronomers. They are really gigantic holes made in the surface layer of white hot gas by electrified particles boiling up from deep within the sun. They break through the surface of white hot gas somewhat as bubbles of steam rise and burst in boiling water. Myriads of the particles then shoot on out into space. When they strike our atmosphere they cause static in our radios and electrical displays called auroras in the night skies of the far north and south. Many scientists also believe that sunspots affect our weather, as explained in the text.

FOLLOWING THE MIDNIGHT SUN



This picture, made by exposing the same plate at 15-minute intervals, was taken by Donald MacMillan at the northern end of Baffin Bay. It shows how, in these high latitudes, the sun seems to move almost horizontally without setting.

old when he arrived there The sun does not seem very large. A fair-sized pea held at arm's length (25 inches) from the eye will cover its disk. But to look even this large, an object as far away as the sun has to be of vast size Astronomers compute that the diameter of the sun is 109 times that of the earth. If the earth could be placed at the center of the sun, the moon, revolving around the earth, would reach only about halfway to the sun's surface.

Knowing the distance to the sun, we can also tell how hot it must be, in order to give out the heat the earth receives. This heat is measured by the *solar constant*, as explained in the article on Climate Hence we know that the sun must have a temperature at its surface of about 10,000° F., or about 5,500° C.

The Nature of the Sun

Such heat is great enough to change any rock or metal to glowing gas. Therefore the sun cannot be solid, like the earth. It must be a globe of hot gas. The telescope shows this gaseous nature plainly. Dark sunspots and bright spots called *faculae* come and go over the white-hot surface. As the sun rotates upon its axis, the spots move with the surface; but they complete a revolution at the Equator faster than they do near the poles. This could not happen on a solid sun.

The surface of the sun's body is called the *photosphere*, meaning "light sphere." Around it is a layer of lighter and cooler gas called the *chromosphere*, meaning "color sphere." This name is given because this cooler gas gives out scarlet light. The photosphere has tremendous clouds, called *flocculi*, of calcium vapor.

Great streamers of scarlet matter, called *prominences*, often shoot out through the chromosphere, sometimes for hundreds of thousands of miles. Some are like flames; others resemble immense bubbles that swell and then burst. Around all this is a zone of electrified material that is far thinner than any gas. Usually this zone cannot be seen, because of the brighter light from the hotter parts. But when the sun's disk is covered in a total eclipse, this zone shows as a dazzling, pearly-white *corona*, or crown.

The Sun and the Solar System

When the sun gave birth to the earth, it gave off also the other planets of the solar system; and it still holds them in their orbits by its gravitational attraction. It can do this because it weighs as much as 332,000 earths and exerts 27.9 times as much gravitational force as the earth does. Because of this, 100 pounds of the earth's matter would weigh 2,790 pounds, or nearly a ton and a half, on the sun. (*See* Gravitation; Planets.)

The belief that the earth came from the sun is supported by the fact that they contain the same chemical elements. The luminous parts of the sun consist largely of hydrogen. More than 60 other elements have also been detected, including oxygen, nitrogen, silicon, magnesium, sodium, potassium, calcium, phosphorus, sulphur, iron, aluminum, and copper. (The methods by which astronomers gain this knowledge are explained in the article on Spectrum and Spectroscope.)

FACTS ABOUT THE SUN

Distance from the Earth—Minimum (January), 91,300,000 miles; maximum (July), 94,500,000 miles, mean, 92,897,000 miles.

Diameter—864,100 miles.

Density—1.41 times the density of water, ¼th as dense as the earth.

Weight in Tons—About 2,184,759 sextillion tons This is written as 2,184,759 followed by 21 ciphers

Surface Temperature—Estimates range from 9,450° F. to 11,070° F.

Output of Energy—894,700,000 calories a minute from each square meter, or 70,000 horsepower from each square yard Total output in calories a second, 907 followed by 23 ciphers.

Width of Disk—About ½ degree (32′).

Period of Rotation—About 25 days at the Equator, 34 days at the poles.

Scientists are still uncertain about the source of the sun's heat. The old theory that the sun was burning was given up when geologists produced evidence that the sun had been hot for hundreds of millions of years. No substance could remain burning that long.

The physicist Hermann von Helmholtz then suggested that the sun's force of gravity might be continually drawing together the matter in the sun and compressing it. Such compression would produce heat, but Lord Kelvin calculated that this process could only continue for some 46 million years.

Modern Theories about the Sun's Heat

Today scientists believe that the sun's heat must come from processes that depend upon the electrical nature of matter. One process is release of energy

through radioactivity. Or heat and pressure in the sun may change matter into energy (*see* Atoms; Physics; Radioactivity).

This is not the same as the burning of matter. Burning changes matter from one form to another, and releases some heat while doing so. But when matter changes into energy, one ounce of matter is estimated to yield energy enough to melt 1¼ million tons of rock. To keep the sun hot in this way, 4,200,000 tons of matter would have to be converted into energy each second. But even so, 1 per cent of its huge mass could maintain the heat of the sun for 150 billion years.

SUN FLAMES BURSTING FORTH

Like a giant fiery bubble, this solar prominence grew to be 250,000 miles high—more than 30 times the diameter of our earth. The start is shown at the bottom, and the final burst at the top.

Sunspots and Their Effects

Sunspots which appear through the telescope as small dark holes in the sun's white disk seem to be a sort of boiling out or release of electrical energy from within the sun. This release sends beams of negatively charged electrons shooting into space.

Some of these electrons enter the earth's atmosphere, where they produce electrical effects such as the aurora borealis. They disturb radio transmission, or even break it down, by raising or lowering the Kennelly-Heaviside layer of electrified material in the upper atmosphere (*see* Aurora Borealis; Radio). They also seem to increase the amount of ozone in the upper atmosphere. The added ozone may absorb more of the sun's heat than usual, and thus affect our weather. It may also have a stimulating effect upon human beings.

Astronomers are sure that sunspots are electrical in nature, because they produce what is called the *Zeeman effect* in spectroscopes. This effect—a splitting of spectral lines—takes place only when light has passed through a magnetic field. From studies of this effect in 1906 and later years, the famous American astronomer George Ellery Hale proved that the spots are really gigantic whirls of electrified matter that come bursting from the sun's interior in pairs, like the ends of a U-shaped tunnel.

Most sunspots last only a few days, but some last two months or more. They increase in number, then diminish, through a regular cycle which runs about 21⅓ years. At the start of the cycle they appear about one-third of the way between the sun's Equator and each pole. For about three years they increase in number, and appear nearer and nearer the Equator. Then the number decreases. This portion of the cycle ends in about 11 years, with only a few spots almost on the Equator. Meanwhile the second half of the cycle has started. In this, the direction of whirl and the electric polarity are reversed. This reversed cycle rounds out the complete period of 21⅓ years.

The sunspot cycle, some meteorologists think, may be the cause of certain periodic changes which have been observed in climate (*see* Climate). Since periods of maximum sunspot activity occurred in 1927, 1938, and 1949, astronomers expect a similar maximum in 1960.

Use of Spectroheliograph

A valuable aid in studying the sun is Hale's spectroheliograph. This instrument is a combination of a spectroscopic camera and a telescope. By using a single line of the spectrum to photograph all parts of the sun's disk in succession, it produces an image revealing otherwise invisible features of the sun's prominences and atmosphere.

SUNDAY SCHOOLS.

"Ah, sir! Could you take a view of this part of the town on a Sunday, you would be shocked indeed! The street is filled with wretches who spend their time in noise and riot, cursing in a manner so horrid as to convey an idea of hell." Thus a woman of the pin-factory district of Gloucester, England, spoke to Robert Raikes, editor of the *Gloucester Journal*, in 1780. Three years later Raikes wrote: "A woman who lives in a lane where I fixed a school told me that the place was a heaven on Sunday compared to what it used to be."

This is one account of how Robert Raikes founded an early Sunday school. The pupils were poor children who worked in factories during the week. Raikes believed that they were vicious only because they were ignorant. His school had classes in reading and writing, as well as in catechism. It kept the children occupied throughout most of Sunday, with sessions from ten o'clock to noon and from 1 to 5.

In America, Sunday schools were devoted solely to religious instruction. Some of the churches in the

New England colonies had classes for children between the Sunday church services, but there were no regular Sunday schools until after the Revolution. In 1786, Francis Asbury, the first Methodist bishop in America, founded a Sunday school in Hanover County, Va. Four years later the Methodist church adopted the promotion of Sunday schools as a policy.

Soon interdenominational "unions" were organized to foster the establishment of Sunday schools. In 1824 many of these joined to form the American Sunday School Union. Sunday schools then spread rapidly. In 1830 the Union reported more than five thousand Sunday schools in the United States. They had almost 350,000 pupils.

Later the Sunday-school movement became international. In 1872 an International Lesson Committee was organized to prepare uniform lessons. Graded lessons were the next great improvement. Sunday schools adopted these in 1908. In 1922 an International Council of Religious Education was formed. About 40 Protestant denominations in the United States and Canada cooperate through this council in planning the work of Sunday schools.

Modern Sunday schools are mainly Protestant. The Roman Catholic church gives religious instruction in its parochial schools.

SUNDEW. There is something almost human—or perhaps it would be more exact to say inhuman—about the way the treacherous little plant called the sundew ensnares its insect prey. The upper surface of each leaf is covered with about 200 hairlike projections or "tentacles"; these are provided with glands which give out a sticky fluid attractive to insects. Each leaf seems to be covered with hundreds of glistening dewdrops; hence the name. If an insect touches the tentacles it sticks fast. Then all the neighboring tentacles begin to bend toward the center of the leaf, rolling the insect along and making the leaf look like a little closed fist. As soon as the prey is caught the fluid secreted by the tentacles becomes acid, containing digestive properties which make soluble all of the nitrogenous parts of the insect.

After the insect is digested—usually about two days—the tentacles all recurve and the leaf trap is set for another visitor. In Portugal there is a plant related to the sundew which catches so many flies that the peasants hang branches of it in their cottages to rid themselves of these pests.

The sundew (genus *Drosera*) is one of the so-called "carnivorous" plants. Several species are found in North America. They are inconspicuous little plants, with round or oval leaves in a rosette, and they grow chiefly in swampy places. (*See also* Pitcher Plants; Venus's Flytrap.)

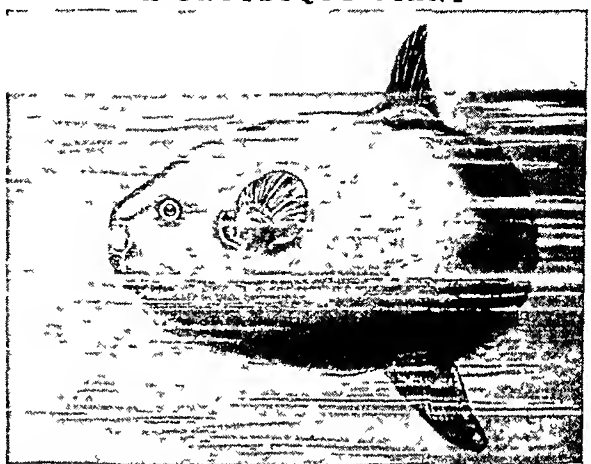
SUNFISH. Where is the rest of him? This is the first question suggested by a glance at the ocean sunfish. What a huge monster he would be, you think, if his tail were not "cut off just behind the ears!"

The true sunfish is this immense creature who wins his title by basking on the surface of the ocean in the hot light of noon. Specimens eight feet long and weighing 1,800 pounds have been caught.

The shape of this fish is like a watermelon seed, and he appears to be nothing but head. Above and below the part that would correspond to the neck are two big triangular fins. Just at the place where he should begin to widen out into a regular fish shape, he stops altogether. It is not surprising that scientists, gazing upon him in wonder, call him a *moloid pelagic plectognath*, or *Mola mola*, for short!

The ocean sunfish is a stupid fish, and will allow men in boats to approach quite close to him before he turns over and dives. For this reason he is easily harpooned, whereupon he puts up a tremendous fight, lashing the water with his two big fins and dragging the craft of his captors at considerable

A GROTESQUE GIANT

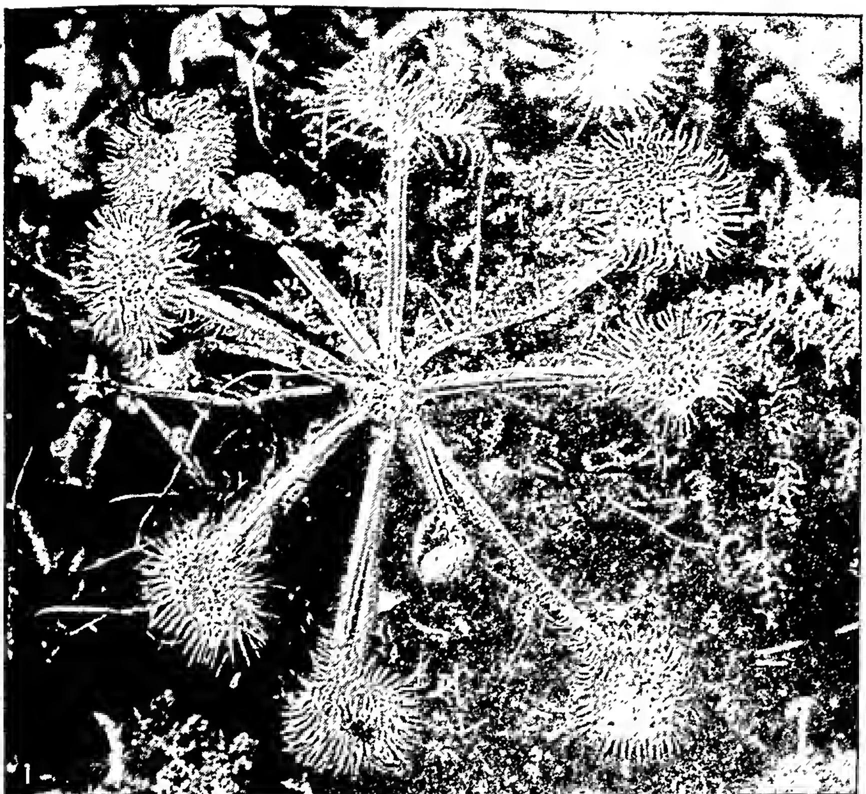


During stormy weather the ocean sunfish lies low, but in sunny weather he loves to play about near the surface, swimming so high that his back fin projects as shown in the picture, or lying flat on his side. "Stupid," he is called; and he looks it, with that gaping mouth and round, surprised, staring eye.

speed over the waves. The sunfish is found in almost all parts of the Atlantic and Pacific oceans. His flesh is not good for food, but he is sometimes caught for the oil which he produces.

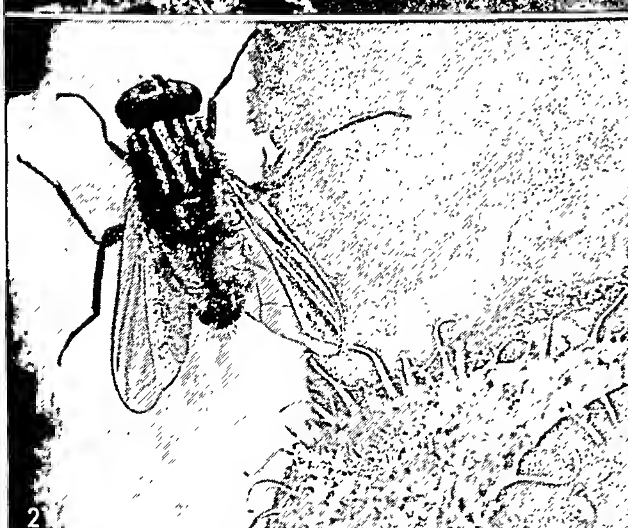
Very different from this ocean monster are the little freshwater sunfish which are among the most characteristic, best known, and most highly esteemed of the game and food fish of the United States. The handsome common sunfish (*Lepomis gibbosus*) is one of the best known. The little green sunfish, the long-eared sunfish, and the bluegill are other well-known members of the sunfish family (*Centrarchidae*), which also includes the large-mouthed and the small-mouthed bass, the rock bass, the black crappie (calico bass), and the white crappie. Many of them build pebble nests in the shallows, where they will get the full force of the sun's rays. The male keeps watch over the eggs until they hatch. (*See also* Bass.)

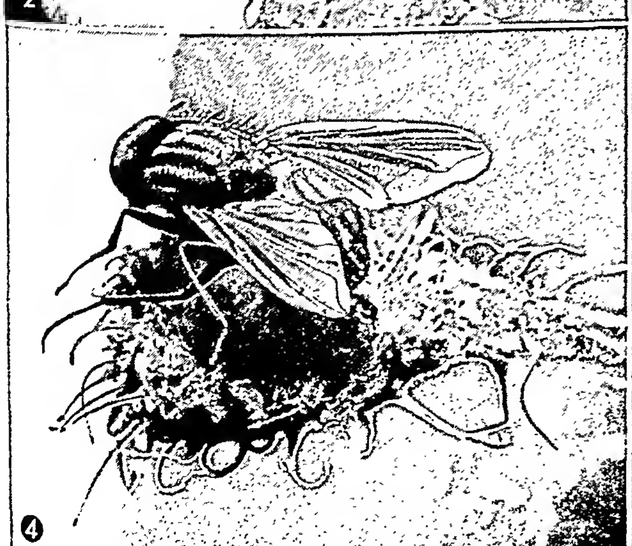
SUNFLOWER. When Champlain visited the Indians on the eastern shore of Lake Huron some three centuries ago, he found them cultivating the large common sunflower, the best-known of the many species of this familiar plant. They had probably brought it from its native prairies beyond the Mississippi. Its stalks furnished the red men with a textile



HOW THE SUNDEW CAPTURES ITS LIVING PREY

1. In this photograph, we look down on a treacherous little sundew plant with all its armlike leaves outspread. The leaves are covered with red glandular hairs tipped with sticky matter that looks like a glistening dewdrop. 2. A fly on a near-by plant has caught the edge of its wing on two of the hairs. 3. The hairs curl toward the center of the leaf and drag in the struggling insect. 4. Completely entangled, the fly cannot escape. 5. Its victim trapped, the leaf folds over the fly to digest it. The leaf reopens when the insect is absorbed.





MANY FLOWERS IN ONE BLOSSOM

The huge head of the sunflower is actually made up of many small separate flowers clustered together to form that dark center. This is typical of the great plant family *Compositae*, of which the sunflower is a leading member (*see* Flowers). The many small flowers are united into a coöperative colony. Those on the rim of the disk produce the gorgeous spread of yellow petals; those on the inside produce the nectar and the seeds. Botanists consider the sunflower one of the most highly developed of all plants.

fiber, its leaves with fodder, its flowers produced a yellow dye, and its seeds furnished food and oil for their hair. Early European settlers in Canada were quick to appreciate the usefulness of this plant and sent seed home to Europe. Sunflowers are now grown commercially in parts of the United States and in many foreign lands. The seeds, rich in fat and protein, are fed to poultry and livestock or are crushed for edible and industrial oils. They may be roasted and eaten like peanuts. The whole plant makes good silage.

The common sunflower is a giant among composite flowers, having large, coarse, heart-shaped leaves and brown-centered golden blossoms which often measure nearly a foot across. The name of the flower comes from its way of turning to face the sun as it moves from east to west and probably also from the resemblance of the golden-rayed heads to the sun.

Scientific name, *Helianthus annuus*. Flowerhead flat, 4 to 12 inches across, with brown, round disk florets crowded in concentric circles on the flat, round disk; ray florets yellow, numerous, long, radiating in series from the disk. Stem rough, hairy, 6 to 10 feet tall. Leaves large, broad, coarse, petioled, and usually growing alternately on the stem.

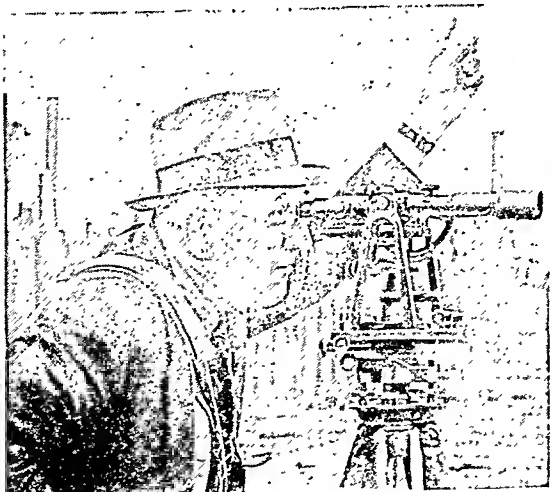
SUPERIOR, LAKE. The largest body of fresh water in the world, Lake Superior is also the deepest, the most northern, and the coldest of the North American Great Lakes. Its area is 31,820 square miles. You may steam for hours across its surface without sighting land, for Lake Superior is 350 miles long from east to west and reaches 160 miles at its widest point. In some places, the cold blue water is 1,290 feet deep. Even summer rarely brings its temperature much above 40° F., and until far into May its ports are icebound.

From the rocky and wooded shores more than 200 streams pour their waters into Lake Superior. Of the islands, the largest, Isle Royale, about 45 miles long and 9 miles wide, falls within United States boundaries. Here is Isle Royale National Park. At the western end of the lake lies the great double port Duluth-Superior, at the edge of the iron regions of Minnesota and the farming country of the west. From here giant freighters carry their cargoes of ore and grain down through the locks of the Sault Ste. Marie at the eastern end, on their way to other ports of the Great Lakes. The return freight is largely coal. About midway on the southern shore the spur-shaped peninsula of the "copper country" juts 60 miles into the lake. Here, from 1850 to 1877, Michigan mines produced as much as four fifths or more of the copper of the nation. Shore towns on Keweenaw Peninsula were busy copper ports. Copper is still mined on the peninsula, but its output is greatly surpassed by mines of Western states. Lake Superior whitefish are highly esteemed throughout the Middle West, and other fish from these cold clear waters are among the best to be found in all the lakes. (*See* Great Lakes.)

SURVEYING. How do you know where the boundaries of your farm or city lot are? Because they have been mapped or laid out by skilled surveyors. It is by surveying that the boundaries of cities, states, and countries, as well as of private lands, are laid out. Surveying is also used in locating streets, roads, railroads, and all other positions or courses on the earth's surface. Surveyors must know geometry and trigonometry and must be able to use delicate instruments with great accuracy. In big cities land is often worth hundreds of dollars a square foot, and an error of a fraction of an inch would be costly.

Surveying, which—at least in a rudimentary form—is nearly as old as civilization, is a branch of civil engineering. It is the science of ascertaining the shape and size of any portion of the earth's surface—that is, the relative location of points and lines—and representing them on maps or diagrams. It includes also the reverse operation of locating or staking out on the ground points and lines drawn in plans or maps—as for the construction of buildings, railways, canals, and the like.

THE SURVEYOR'S EYE



Looking through the telescope of his transit (theodolite), a surveyor can measure horizontal and vertical angles and sight accurately in any direction. He sets the transit in a horizontal plane by adjusting the set screws at the base until the bubbles are centered in the two spirit levels above the circle. The tube below the telescope holds another spirit level for use in measuring vertical angles.

There are two principal kinds of surveying—plane and geodetic. Plane surveying—including land, topographic, and hydrographic surveying—deals with small areas. It treats the earth's surface as a plane, disregarding its curvature. Geodetic surveying, or "geodesy," deals with larger areas and is more accurate, taking into account the curvatures of the earth's surface.

The simplest method of land surveying is to divide the ground to be surveyed into several triangles and to calculate the area of these triangles. A base line is marked off and measured with great accuracy. Another point is chosen for the apex of the triangle and the angles it makes with each end of the base line are measured. From these angles and the length of the base the area of the triangle is calculated. By continuing this process until the whole piece of land is covered with a network of triangles, the location of all important points throughout the entire area is computed. A number of spots

are marked with monuments, to serve as starting points for any local surveys that may be desired.

In making his measurements and determining his angles, the surveyor uses special instruments of great accuracy. The principal instrument is the "transit" (an improved form of the "theodolite"), which consists of a telescope mounted on a tripod with a compass and a leveling glass attached. If a straight line running northward is to be laid out, the instrument is swung around until the compass shows that it is pointing directly to the north, then the surveyor looks through the telescope, while his assistant carries a long rod forward, planting it in the ground at the direction of the surveyor in the exact line of sight, determined by a hair which is stretched perpendicularly across the inside of the telescope. The transit is then moved up and planted exactly over the spot marked by the rod, the assistant moves forward again, and the whole process is repeated. If the line is to bend at a certain angle, a scale on the transit tells when the telescope has been moved to that angle and the sighting goes on as before.

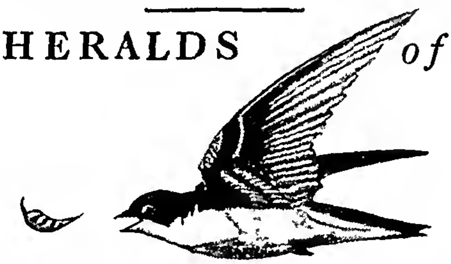
When distances are measured along the line of sight, wire chains or metal tapes are used. For farm or public land surveys in the United States the Gunter chain is used, which is 66 feet long, divided into 100 links each 7.92 inches. These are units of acre measurement. But for more accurate engineering work, steel tapes marked in inches, feet, and ten-foot lengths are used. For very accurate work, tapes are made of "invar," an alloy of nickel and steel which does not expand or contract in response to any changes of temperature ordinarily encountered.

The "level" is an instrument somewhat like the transit, but used chiefly to determine grades, that is, the amount of rise and fall of the ground surface. It is used chiefly for railway and topographic surveys, the latter dealing with the shape of physical features, such as rivers, hills, and mountains. The "plane table" is a drawing board, which may be fixed horizontally on a tripod with a spirit level. It is usually used with an "alidade," a combined ruler and telescope for drawing lines parallel to the telescope setting. Some surveying is now done much faster than formerly from airplanes.

Geodetic surveys take into account the curvature of the earth. They are carried on by governments to map the coast lines, to determine the exact heights and locations of important points, the boundaries and areas of states, of large bodies of water such as the Great Lakes, and international boundaries. For this purpose geodetic survey stations are established in various parts of the United States, Canada, and Mexico, whose exact positions are determined by astronomical observations, corrected by a complicated process of triangulation. The central station for North America is at Meade's Ranch, Kan.

Hydrographic surveying deals with the area, shape, and depths of bodies of water, and is made with the assistance of soundings. By this means, channels, banks, and sunken reefs are charted, and ocean depths marked on maps. (*See also* Lands, Public; Maps)

FEATHERED HERALDS *of* SPRINGTIME



SWALLOWS, SWIFTS, AND MARTINS. Are you troubled by mosquitoes and flies? Put a martin house in your dooryard and you will soon be relieved of these pests For the martin and his relatives, the 200 species of swallows and swifts, are insect-eating birds and feed especially on the small flying varieties. They capture them in the air, and so keep their mouths widely agape when on the wing.

The swallow family is known and loved throughout the world. To many the unfailing sign of spring is the arrival of flocks of these picturesque steel-blue birds. The pointed wings and forked tail are characteristic of the family, which in general has dark over-plumage, changing to lighter below. The species vary in size from five and one-half to eight inches, but the habits are similar for all.

They live mostly on the wing. In migrating, unlike other birds, they travel only during the day, for they can feed as they fly, roosting in marshes or trees at night. Most of the swallows nest in colonies and all lay from three to seven eggs. The choice of place and the manner of building, however, varies widely with the different species.

The purple martin is the aristocrat of the swallow family and prefers to carry the leaves, straw, and mud with which he builds into a box erected for his use. This home he defends against any other bird, even the crow or hawk. His entire body is covered with dark steel blue, the wings and tail being almost black-purple. The violet-green swallow, not five inches long, lives in the western United States. It is named for the colors on its back, the belly being white

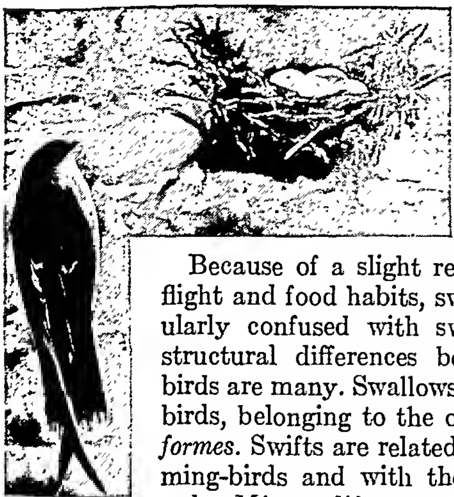
The barn swallow, with his under-feathers of chestnut red, is the master mason of the family, and constructs a wonderful little nest-house of straw, held together with mud-pellets, and attached under the eaves or against the beams of buildings and under the ledges of cliffs. As the song says:

> The swallow is a mason,
> And underneath the eaves
> He builds a nest and plasters it
> With mud and hay and leaves

Bank and rough-winged swallows have a curious way of tunneling into a sand-bank, sometimes to a depth of three to five feet. Into this burrow they carry straws and sticks and build a bulky nest.

Holes in trees or old stumps are the usual nesting sites of the tree swallow, but this species sometimes nests in the bird boxes made by man.

CHIMNEY SWIFT AND HER NEST



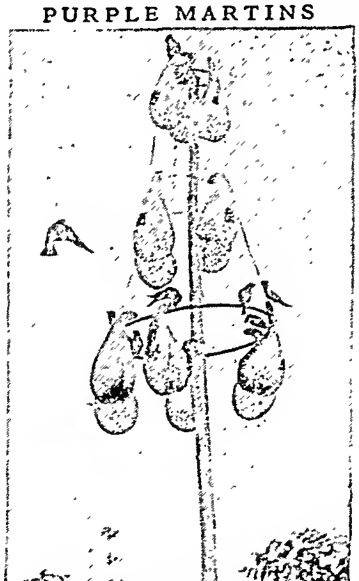
The swift has forsaken the hollow tree in which it used to build its nest for an unused chimney. Like the swallow, it nests in colonies.

Because of a slight resemblance in flight and food habits, swifts are popularly confused with swallows. The structural differences between these birds are many. Swallows are perching birds, belonging to the order *Passeriformes*. Swifts are related to the humming-birds and with them form the order *Micropodiformes*.

The swift constructs a nest of twigs held together by a glue-like liquid substance which flows from the mouth of the bird during the mating season. In some cases, notably in that of the swifts of Japan and China, the nests are composed entirely of this glue, with perhaps a feather lining. These nests are considered a table delicacy, and "bird's-nest soup" is a dish of which both Japanese and Chinese are very fond.

Chimney swifts are about five and one-half inches long, usually sooty or brown color above and lighter below. Because of the shape of its claws the bird never perches on trees or other objects, but alights in a hollow tree or chimney where it clings to the sides by its sharp claws, supporting the body by pressing the tail against the wall. In such homes they glue their shelf-like nest so firmly that it supports not only the mother but also her five or six babies. Of course if the chimney is heated, disaster follows.

PURPLE MARTINS



This village of gourds houses a colony of the biggest, handsomest, jolliest, and most domestic of the swallow family—the purple martin.

When the children are able to fly, the swifts gather in immense flocks and use the same chimney for sleeping quarters. John Burroughs tells of watching 10,000 swifts playing above a single tall chimney, into which the entire flock finally disappeared for the night. This they continued to do for a whole month before migrating to the south.

The migration of the swifts was long a mystery. After gathering in vast numbers on the northern coast of the Gulf of Mexico, they apparently disappeared. To discover what became of them, the United States Fish and Wildlife Service banded some 375,000 birds. The first evidence of their winter whereabouts came in 1944, when Indian hunters in a Peruvian jungle recovered 13 bands from swifts they had shot. (For illustrations in colors of the barn swallow and the chimney swift, *see* Birds.)

BARN SWALLOWS

This is one of the hungry chattering broods that populate the eaves of barns and other farm buildings. Before men provided the Barn Swallow with a nesting place, it used to build in caves, niches in rocks, or hollow trees.

Swallows belong to the family *Hirundinidae*. Scientific name of purple martin, *Progne subis subis;* barn swallow, *Hirundo erythrogaster;* tree swallow, *Iridoprocne bicolor;* bank swallow, *Riparia riparia riparia*. The swifts belong to the family *Micropodidae*. Scientific name of chimney swift, *Chaetura pelagica*.

SWAN. The swan is called the "royal" bird, for in England up to the time of Queen Elizabeth I no subject might possess a swan without license from the Crown. The title still clings to the bird, probably because the dignity of its appearance makes it peculiarly apt. The swan frequently appears in myth and fable, and its beautiful plumage, the proud poise of its graceful neck, and its stately movements have made it a favorite subject in literature.

Swans are almost exclusively water birds. There are about eight species. They are all large birds, with very long necks. In some species the neck is longer than the body. The plumage is white in the adult swans, and in the first-year young it is brownish. The call note is loud and trumpetlike. Young swans are called "cygnets." The male is called a "cob"; and the female, a "pen."

The distribution of the swan family is very wide. Wild swans breed in the arctic region, migrating to warmer climates in the winter. The nest of the swan is a large pile of reeds and water plants, and the eggs, about six in number, are of a greenish hue. The birds feed on seeds, roots, small water creatures, and fish spawn.

The common swan of Europe is also called the mute swan, for it is said never to use its voice in captivity. This species, the best known of the family, reaches a length of five feet and a weight of 30 pounds. The plumage is spotless white, the bill of orange-red surmounted by a black knob, and the legs are black. Domesticated swans of this species consort freely with wild swans, which migrate southward toward

winter. It has been introduced and naturalized along the central Atlantic coast of the United States.

South America is the home of the black-necked swan, a smaller bird with white plumage except for the head and neck of dark seal-brown. Australia has the black swan, with sooty black plumage, white primaries, and coral colored bill. This handsome bird is the state emblem of Western Australia.

In North America the family is represented by two native species—the trumpeter swan, largest of North American wild fowl, and the whistling swan. Both are now very rare. (For picture of trumpeter swan, *see* Birds, B-193.) These birds have a great variety of calls, ranging from the high-pitched note of the young birds to the bass-horn notes of the old males. The "swan song" of the dying birds, so long regarded as a pleasing myth, has actually been heard from birds of these species as, after being wounded, they slowly sailed to earth on set wings.

Swans, geese, and ducks form the family *Anatidae*. Scientific name of swans trumpeter, *Cygnus buccinator;* whistling, *Cygnus columbianus;* mute, *Sthenelides olor*.

A GRACEFUL SWAN MOTHER AND HER BABY

This snowy, stately bird sits on the nest while her offspring snuggles safely among the soft feathers that grow between her wings. Notice the distinctive bill, characteristic of the mute swans.

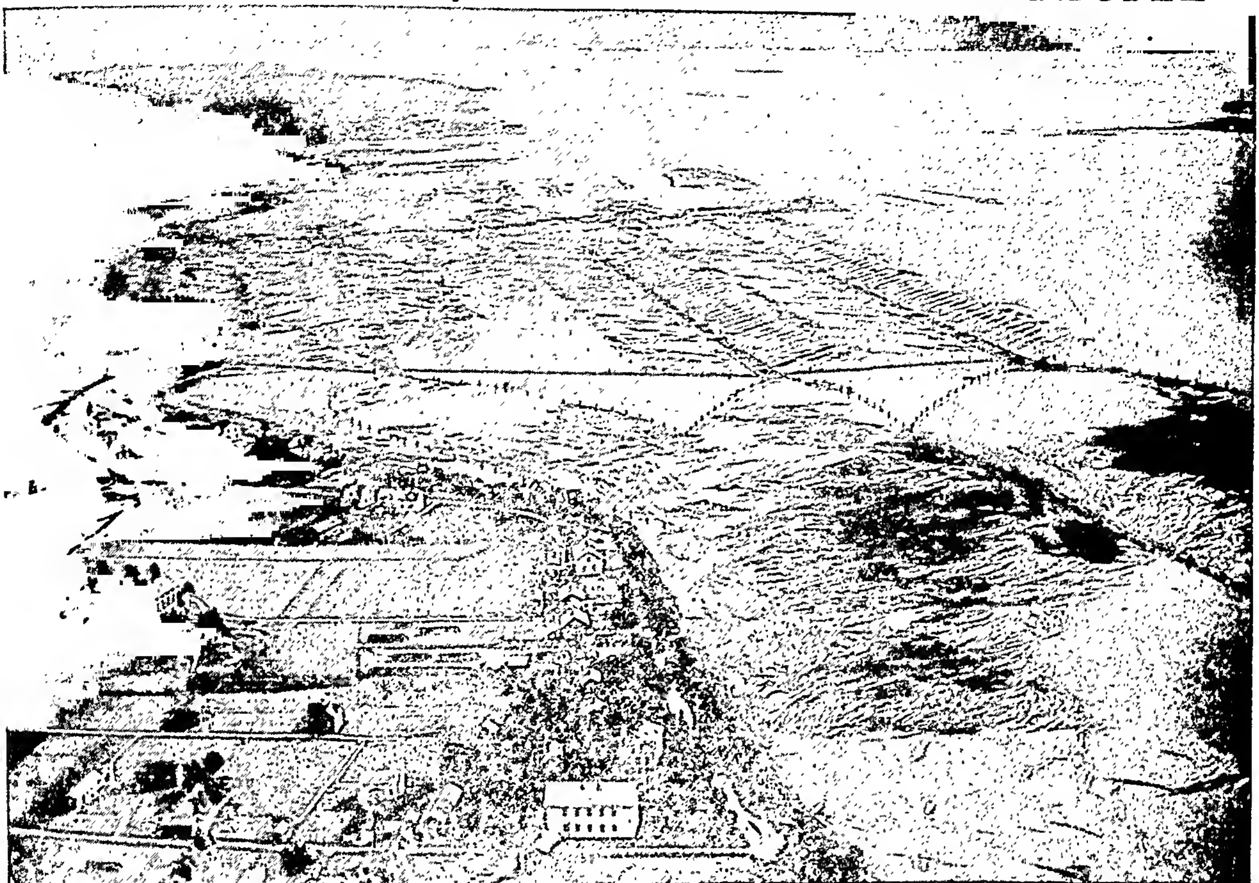
Sweatshop system. This term is applied to manufacturing carried on under such wretched conditions and with such low wages that the employer is said to "sweat" his employees. The name was given by Charles Kingsley, the English clergyman, sociologist, and writer, who was one of the first to agitate against the abuse. In the United States, 30 per cent of all clothing manufactured in 1892 was made under the sweatshop system.

Sometimes sweatshop work was done in a room hired by the employer. The quarters were often extremely crowded and lacked proper lighting and sanitary arrangements. Sometimes the work was done at home, and then it was called "industrial homework." The materials were often handled by persons who had contagious diseases. The workers' homes—already cramped and unsanitary—were further crowded by bringing outside laborers into the home workshops. Workers often toiled 15 hours a day, seven days a week, at wages so low as barely to enable them to keep alive. Among the chief industries in which "sweating" occurred were the making of garments, cigars, artificial flowers, table favors, and candy.

Such conditions are largely a thing of the past, though they have not been entirely remedied. In addition to regulating work in factories, many states have passed laws regulating industrial homework as well. But enforcement of homework laws is difficult. Another obstacle is that in many trades sweatshop workers have been slow to join trade unions. Under the National Recovery Act of 1934 (which was later declared unconstitutional), certain types of homework were for a while prohibited in an effort to raise wages and lower hours. But certificates had to be granted to some persons who had to work at home

The most effective fight against sweatshop methods finally came through Federal and state wage-and-hour laws. In 1938 the federal Fair Labor Standards Act, affecting industries engaged in interstate commerce, remedied many sweatshop practises. It provided a minimum wage of 40 cents an hour, time and a half for overtime after 40 hours, and child-labor standards. Amendments effective in 1950 raised the hourly minimum wage to 75 cents and strengthened child-labor laws. By 1951 about half the states had minimum-wage laws. (*See* Child Labor Laws; Labor.)

SWEDEN'S *Peaceful Land and* STURDY PEOPLE



Timber Cut in the Mountains Floats to the Mills on Broad Swift Rivers

SWEDEN. Once an extremely warlike nation, Sweden has been at peace longer than any other European country save Switzerland. The Swedish people say that this record is the fruit of moderation and middle-of-the-road common sense. They have learned how to prosper without struggling with their neighbors for power.

Extent.—North to south, about 1,000 miles; east to west, about 250 miles. Area, 173,423 square miles. Population (1950 census, preliminary), 7,046,920.
Natural Features.—Surface in general an undulating plateau falling in terraces from the west to the low Baltic Plain on east and south. Chief mountain range, the Kjölen (or Keel), which separates Sweden from Norway; highest peak, Kebnekaise (7,005 feet). Many lakes and rivers, occupying together more than 8 per cent of the area. Largest lakes: Vänern (2,149 square miles), Vättern, Mälar, Hjelmar. Rivers: Dal, Klar, Ljusne, Ljungan, Tornio, Kalix, Lule, Skellefte, Ume, Vindel, Angerman, Indals.
Products.—Oats, rye, barley, potatoes, sugar beets, wheat, hay, flax; cattle, sheep, goats, swine, reindeer; dairy products; fish; iron, zinc, manganese, lead, coal; iron and steel products; timber, furniture, pulp and paper, matches, and other wood products; porcelain, glass, cement, chemicals; cream separators, ball bearings, telephones, electrical and farm machinery, motors.
Cities.—Stockholm (capital, 745,936); Göteborg (353,991); Malmö (192,498); Norrköping, Hälsingborg, Örebro, Borås (over 50,000).

(For map of Sweden, *see* Norway.)

They have managed to create for themselves one of the most democratic societies in the world by gradual reforms without upheavals or revolution.

That the Swedes work so well together is partly explained by the fact that the people have a common origin and tradition with few variations in race, language, or religion. For 10,000 years they have lived in this far northern land of mountains, lakes, and forests. Practical, industrious, and persevering, they have made the most of such advantages as their land offers, and have overcome natural drawbacks that would have dismayed a less resolute folk.

Sweden occupies the eastern and larger part of the Scandinavian peninsula that hangs like a claw hammer over the European mainland (*see* Scandinavia). Its area is about one third greater than that of Norway and about one sixth larger than that of California. The high plateau of the age-worn Kjölen Mountains separates it from its western neighbor, Norway. The land slopes steeply eastward toward the Gulf of Bothnia and more gradually southward to the Baltic Sea. In the north, the Muonio and Tornio rivers form a boundary with Finland. Sweden's southern tip pushes into the Baltic some 250 miles beyond its juncture with Norway. It overlaps the Danish peninsula and reaches within 90 miles of the German coast. Along its western shores are the waters that link the Baltic with the North Sea—the narrow arm of the Sound, the broad Kattegat, and the Skagerrak.

Sweden's entire coast is studded with islands. The largest are Öland and Gotland, off the southeastern coast. Across the mouth of the Gulf of Bothnia lie the Aland Islands, which belong to Finland.

Climate under the Midnight Sun

About one seventh of Sweden lies beyond the Arctic Circle. It stretches across the same range of lati-

tude as Alaska, so its summers are short and cool. Winters last from seven to nine months, with little spring or autumn. Since the western mountains shut the tempering Atlantic winds from two-thirds of the country, the extremes of temperature are greater than in Norway. The Gulf of Bothnia is frozen from November to mid-May, and navigation is hindered by ice in the Baltic Sea. In the northernmost regions the sun does not set from late May to mid-July, and for six weeks during the winter it does not rise above the horizon. The southern third of Sweden enjoys milder temperatures and more rainfall.

Divisions of the Swedish Homeland

The traditional regions of Sweden are Norrland, the vast cold, sparsely settled north country covering 60 per cent of the land and extending south to the 61st parallel of latitude; Svealand, the original Sweden proper, including Stockholm and Uppsala and the lake country to the west; and Götaland, or Gothland, from Göteborg southward, which was the ancient home of the Goths, whose invasions of Europe started the overthrow of the western Roman Empire (*see* Goths).

Norrland's mountainous spine and furrowed slopes are covered by forest, chiefly pine and spruce, with wind-swept birch on the highest, coldest ridges. Down from the hills run a series of rivers, pushing southeastward toward the gulf. The glaciers that covered this land in the Ice Age left piles of debris along these rivers which dammed their upper courses and formed long, slender lakes. This extensive river system aids logging, for no part of the forest lies more than 20 miles from a stream. The loggers cut the trees in winter and skid them over the packed snow to a creek or river. When the ice melts in spring the timber washes down to the river mouths. Sawmills and pulp mills in the port towns work part of the logs, and the rest are shipped by sea to the factories or exporting points of southern Sweden.

SMILING COUNTRY LASS

This girl from the Uppsala countryside wears the traditional peasant costume of her region. Today these bright garments are seldom worn except during holiday festivities.

Farmers along the Norrland coastal plain cultivate crops that will mature in the short growing season. They raise hay and other fodder crops for the livestock that must be fed in the barns during the long, cold winter. In the summer they drive cattle, sheep, and goats to mountain pastures. They may work at a sawmill, a logging camp, or a mine for part of the winter. In the far north the nomadic Lapp tribes wander over the country seeking forage for the herds of reindeer that furnish them with food and with skins for clothing and tents (*see* Lapland).

At Kiruna and Gällivare in the northern mountains immense deposits of iron ore lie so near the surface that they can be mined with power shovels. Some of the countless waterfalls provide hydroelectric power for the trains that haul ore to Lulea on the Gulf of Bothnia or over the divide to Norway's ice-free port of Narvik. The electricity also lights the mine fields during the months of Arctic darkness and drives the mining machinery.

The countryside occupied by Svealand and Götaland may be divided geographically into three parts. First comes the great lakes region, a low-lying area where canals have been built to link the streams and lakes forming a convenient water transport system. The Göta waterway, which connects the port of Göteborg and Stockholm, follows a beautiful scenic route that winds through Lake Vänern, Lake Vättern, and Lake Mälaren. This is the industrial, commercial, and historic heart of Sweden, as well as a thriving farming and dairying region. Its beds of excellent iron ore made possible the early development of a world-renowned iron and steel industry.

To the south rises the Smaland plateau, a rough, hilly section where the boulders left by the retreating glaciers test the patience and skill of the farmers. Broad-leaved trees growing in the Smaland forests furnish wood for the gigantic Swedish match industry, of which Jönköping is the center. The finest farm land in Sweden stretches across Skane, at the tip of the Swedish peninsula. This level, fertile land raises about a quarter of the country's food. Some coal is mined here.

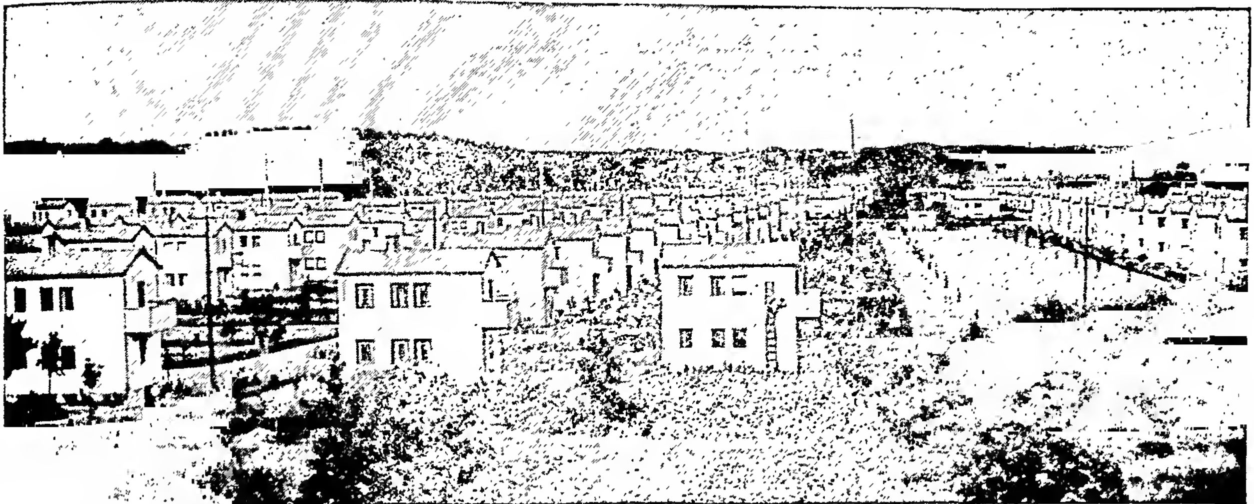
Farming and Industry

Despite the chilly climate and the scarcity of fertile, readily cultivated soil, some 40 per cent of the Swedish working people engage in farming. The chief crops are oats, wheat, rye, barley, potatoes, sugar beets, forage roots, and hay. Stock raising and dairying have increased greatly in recent decades. The average farmer cultivates about 25 acres. Though the country exports some foods, such as bacon and butter, one-fifth of its imports are foodstuffs.

Sweden's enormous industrial development, which began late in the 19th century, has drawn into industry more than one-third of the employed. The forests that cover 60 per cent of the country supply the most valuable raw material. The state supervises logging and replanting so that the annual growth of the trees keeps pace with the amount of timber cut. Lumber, pulp, paper, matches, furniture, boxes, and other wood products are shipped to every part of the world.

Swedish iron and steel played an important part in making the nation a world power in the 17th century. The iron of central Sweden is exceptionally pure, and the forests furnished unending supplies of charcoal for smelting. The introduction of coke smelting in the 18th century handicapped Sweden, because it lacked coal. But the charcoal forges still turn out iron and steel of highest quality as do the newer methods of electrolytic refining. The fine steel goes

AN EXAMPLE OF SWEDEN'S PROGRESSIVE SOCIAL PROGRAM



This suburban village for workers was developed by the city of Göteborg. Only a good citizen and steady worker may buy a house here. The city advances the money, and the worker repays it in installments. If he moves away, he must sell the house back to the city. The dwellings are heated by a central plant. Good, low-cost housing is a part of Sweden's advanced social program.

into ball bearings, machinery, electric apparatus, and household wares. A large share of the iron mined in the Norrland is shipped to countries where coking coal is plentiful.

Chemicals, ceramics, glass, rayon, and other textiles are important manufactures. The chief industries are in Stockholm, Göteborg, Malmö, Norrköping, Hälsingborg, Orebro, Boras, Eskilstuna, and other central and southern towns.

Hydroelectric resources have been more widely developed in the south than in the north. The most important railway lines are powered by electricity. More than half of the lines are owned by the state. It also holds large areas of forest and mineral land and operates many hydroelectric plants. Swedish shipowners operate large fleets of ocean vessels, and shipbuilding and fishing are important.

Some Historic Cities

Sweden's cities are noted for their beauty, their cultural institutions, and their historic interest. A group of rocky islands and peninsulas on the shores of Lake Mälar provide a superb setting for the handsome buildings of Stockholm, the capital and largest city (*see* Stockholm). Historic Uppsala was the ancient seat of the Swedish kings and of the pagan worship of the Norse gods—Odin, Thor, and Freya. At Uppsala, the seat of the archbishop of the Swedish Lutheran Church, stands the great brick cathedral of Gothic origin. The university, founded in 1477, is Sweden's oldest. A 16th-century castle begun by Gustavus Vasa crowns a low hill.

In Visby, on Gotland Island, ruined medieval ramparts, churches, and houses tell of the day when the city was a fabulously rich member of the Hanseatic League. Archeologists have found the remains of extensive iron works and relics that go back to the Viking age. Malmö, just across the Sound from Denmark, also flourished in Hanseatic times and is still a busy port and manufacturing city. Göteborg, on the Kattegat, Sweden's chief port, has an ice-free harbor on the Atlantic. Near-by Bohus Castle, built in 1308, was one of the famous strongholds in the wars between the Danes and the Swedes.

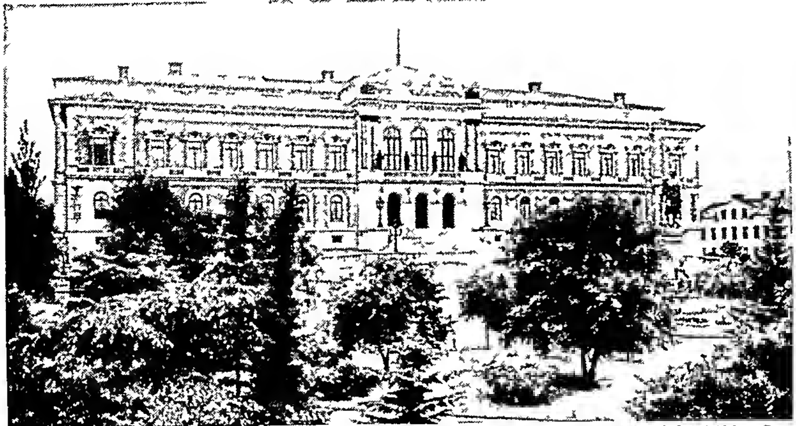
HOW SWEDEN HARNESSES ITS NATURAL RESOURCES

This scene at Avesta is repeated often in industrial central Sweden. The hydroelectric plant at the center has harnessed the river to make cheap power for the steel mill at the right. The logs caught at the dam have floated down from the forested hills. They are ready to be turned into the charcoal that feeds steel furnaces in this country where coking coal is lacking.

Old Ways and New in Sweden

Life in Sweden mingles traditional customs with modern advances. Electric lights are found in two-thirds of the farm homes. Under their bright lights housewives do home tasks according to customs handed down from medieval times. Many women shear their sheep and spin and weave the wool. Thrifty girls fill hope chests with enough handwoven household linen for a lifetime's wear.

SWEDEN'S OLDEST AND LARGEST STATE UNIVERSITY



Uppsala University, whose main building is shown here, was founded in 1477. Its library holds priceless historic manuscripts, and one of its botanic gardens was designed by the great naturalist Linné (Linnaeus).

Much linen and clothing are required in rural homes where the custom of the "big wash" is followed. Soiled things are saved for half a year before the farm women haul them to the nearest lake for a giant wash day. In the field, the farmer drapes his grain on a rack to dry, in the time-honored fashion, though he may have a thresher run by electricity.

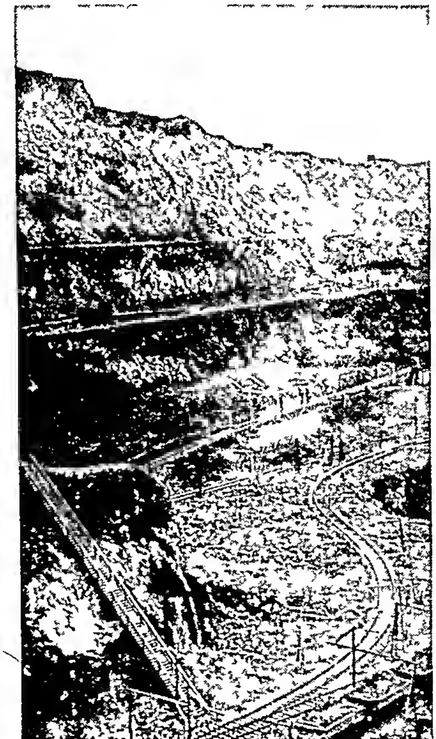
Remote, northern farmsteads must be virtually self-sufficient, producing nearly everything the family needs for food, clothing, and shelter. But farm families of central and southern Sweden, on good highways, can shop as easily as city dwellers. The nearest village holds a farmer's fair every week or two. Here the farmer can trade or sell his livestock, while his wife buys a dress at a fair booth or in a store, and their children listen to the side show barker and watch the racing wooden horses on the merry-go-round. Even more convenient are the grocery and meat stores in trucks which bring their wares right up to the farmhouse door. Many stores are operated by cooperative societies, to which more than one quarter of the people belong (*see* Cooperative Societies). Cooperatives handle the marketing of many farm products. Some of them manufacture shoes, rubber goods, and electric lamps.

Visit to a Typical Farm Home

The typical farm home in this forested land is a frame building painted red, with a neat white trim. Often a house of logs, similar to America's pioneer cabins, is built first, and its chinks filled with plaster or reindeer moss. Then wide planks are nailed vertically on the outside and each crack is covered by a narrow strip of wood. The inside is smoothly plastered. Fireplaces or tile stoves warm the rooms. Often a modern range sits inside a giant fireplace.

There's work to fill each minute of the long summer day. Farmers start so early in the fields that the children bring them jugs of coffee and baskets of food at midmorning. The children also feed the pigs and calves, and drive the cows to pasture. In the evening the boys help set the nets that catch perch, eel, and pike for the delicious fish dishes on the heavy-laden *smorgasbord* table. The girls aid in churning butter and molding cheese in the spring house The dark winter days are busy too, for then the girls learn to knit and sew; and the lads mend harness and tools, or whittle wooden bowls, spoons, and toys.

IRON MINING IN THE ARCTIC



Power shovels scoop up the ore from the surface and load it on flat cars at the Kiruna iron mine, pictured here. The ore trains are drawn by electric engines. Electric lights flood the cut during the dark days of the Arctic winter.

Excellent Educational Opportunities

School takes up most of the children's time, for elementary education is universal and illiteracy is virtually unknown. Graduation brings a trip to Stockholm, where the children see the palaces and public buildings and examine the historic relics in the Skansen outdoor museum. Later the young people may go to an agricultural or home economics school, or prepare for one of the national universities at Uppsala or Lund or a private university at Stockholm or Goteborg Folk high schools scattered over the country offer a few months' of practical "training for life."

Many people continue their education in study circles and lecture courses which are organized by farm clubs, labor groups, temperance societies, or cooperative associations These classes stress citizenship problems, and help to explain Sweden's high standards of government Sports and gymnastic clubs thrive in city and country alike. In winter the Swedes ski, skate, skate sail, and toboggan. In summer they sail, cycle, play tennis, and swim Their hardy outdoor sports and work, together with their good standard of living and their state-wide health program, account for their robust health and long life.

Holidays, Customs, and Government

In Sweden every season has its feasts and holidays, which are celebrated with ancient ceremo-

nial. Midsummer Day—June 24—is the gayest. Every farmhouse doorway wears a garland of greens, and flowers fill the rooms. The young folk troop to the village to dance around the Maypole and to choose the fairest miss for Midsummer bride. On Midsummer eve the children watch for the fairies and wood trolls. City people enjoy spending the holiday in the lovely Dalecarlia region around Lake Siljan. The folk here carry out the old customs faithfully, wearing gay, traditional costumes.

The Swedish custom of abundant hospitality goes back to an era when cold-numbed travelers sought shelter at remote manor houses. Today even the briefest caller is regaled with coffee, fancy breads, and other refreshment. For Christmas, housewives begin preparing traditional Yuletide dishes on St. Lucy's Day, December 13. Feasting starts the day before Christmas, and the parties last through Canute's Day, January 13 (*see* Christmas, *subhead* "Christmas Today in Northern Lands").

The government is a limited monarchy, with a king, a council of state, and a parliament of two chambers, called the *Riksdag*, which dates back to 1435. Men and women over 23 years of age have the right to vote. For administrative purposes the country is divided into 24 *län*, or provinces.

IN THE LAKE COUNTRY

In this aerial view we see one of the canals built by Swedish engineers to link the lakes and rivers into a far-reaching waterway system. It bypasses the rapids in the river to form a navigable outlet for the lake. Notice the rafts of logs waiting to be towed through the canal.

Sweden's History from Viking Days

The history of early Sweden is found chiefly in its many sagas—legends and tales of heroes. Like Denmark and Norway, the land was first organized as a state by the Scandinavian Northmen, or Vikings, who were the terror of Europe in the 10th century (*see* Northmen; Scandinavia). Christianity was not fully established until the 11th century.

The able political genius Margaret, regent of Denmark and Norway, brought Sweden under her sway by the Union of Kalmar in 1397. The oppression and misrule of her successors, however, weakened the Union. Norway and Sweden were enjoying almost complete independence, when Christian II came to the Danish throne in 1520. He decided to unify his kingdom by striking a blow at the powerful Swedish nobility and thus securing the support of the peasantry. With savage perfidy, he lured the nobles to an assembly at Stockholm and brutally slaughtered them.

The Revolt of Gustavus Vasa

This gruesome episode, known as the "Blood Bath of Stockholm," aroused the patriotism of the peasants, who accepted the fiery leadership of Gustavus Vasa. This energetic young nobleman had escaped from a Danish prison and returned in 1520 to Sweden, where he learned that his father and brother-in-law had been killed in the Blood Bath. Roused to vengeance, he assembled his peasant troops. Vanquishing the Danish garrisons sent to meet him, he marched to the very gates of Stockholm. His poorly equipped soldiers were being repulsed when the news came that the Danes themselves had ousted King Christian. At once the Danish army vacated Stockholm. Gustavus Vasa was elected king of Sweden on June 6, 1523.

Out of an impoverished country King Gustavus created a new Sweden. A break with the pope resulted in the establishment of Lutheranism as the state religion, and the ecclesiastical wealth and the magnificent castles of the bishops were seized by the state. Gustavus restored order to the administration, subdued repeated uprisings, and supervised the development of agriculture, mining, and trade. During most of his reign he ruled absolutely alone, trusting not a single person with even minor duties. At his death in 1560 he left Sweden a real power in Europe.

Eric XIV, his eldest son, succeeded Gustavus. During the eight-year rule of this insane king much of his father's constructive work was destroyed. Eric was finally dethroned and imprisoned. Under his irresolute brother, John III, national disintegration proceeded. Four years later John's son Sigismund mounted the throne. Sigismund, who was a Catholic, had inherited the Polish crown from his mother, and Polish domination so roused the national spirit of the Swedes that, led by Charles Vasa, the king's uncle, they revolted. Sigismund was deposed, and his uncle received the crown as Charles IX. Charles re-established Protestantism but quarreled with his neighbors, and on his death in 1611 he bequeathed to his illustrious son, Gustavus Adolphus, the rule of a country entangled in wars with Russia, Poland, and Denmark.

Reign of Gustavus Adolphus

The 17-year-old Gustavus, already a brilliant scholar, administrator, and general, was fitted for his task. From childhood he had been trained to be king, and had fought great winning battles with the Danes. First the young king concluded the war with Denmark, so that he might be free to deal with Russia and Poland. By the treaty at Stolbova in 1617,

he took possession of the Russian territory along the eastern shores of the Baltic. The war with Poland was not concluded until 1629. Next, he championed the Protestant cause in Germany in the Thirty Years' War, but after a series of successful battles he was killed in the battle of Lützen in 1632, leaving Sweden one of the leading military powers in Europe. (*See* Gustavus Adolphus.)

By the treaty of Westphalia in 1648, which concluded the Thirty Years' War, Sweden secured western Pomerania, Wismar, the archbishopric of Bremen, and the bishopric of Verden.

The crown now fell to Christina, the six-year-old daughter of Gustavus Adolphus. Until she was 18, the government remained in the expert hands of Axel Oxenstjerna, her father's famous chancellor. Christina encouraged mining, manufacturing, and trade. Noted scholars, philosophers, and artists crowded her luxurious court. Yet this brilliant and educated queen squandered the state wealth on her favorites and worried her subjects by her weak foreign policies. After a ten-year rule she abdicated in favor of her cousin, who became Charles X.

Charles plunged into wars with Denmark and Poland intent upon making the Baltic a Swedish sea. His brilliant military exploits were ended abruptly by his death in 1660. His son, Charles XI, struggled valiantly in his long reign to save the Swedish power, but the collapse came during the reign of the next king, Charles XII. For a time this boy king held off his enemies, Russia, Poland, and Denmark, but in 1709 Sweden lost power when Peter the Great defeated Charles decisively at Poltava (*see* Charles XII). By the Peace of Nystad (1721) Sweden lost most of its prized possessions on the eastern shores of the Baltic. Finland also was lost (1809) in a disastrous war with Russia. By the Peace of Kiel (1814) Norway was taken from Denmark and placed under the Swedish king (*see* Norway), but in return Swedish Pomerania went to Denmark.

The present ruling house of Sweden stems from Bernadotte, one of Napoleon's marshals, who was elected crown prince in 1810. In 1905 Norway severed its connection with the Swedish crown and chose its own king. The year 1907 saw the beginning of the long and peaceful reign of King Gustavus V. Under him Sweden developed a broad program of social welfare and made notable economic progress. The country remained neutral during both World War I and World War II. During World War II, in 1939, Britain and France demanded that Sweden open its borders to Allied aid for Finland against Russia. Sweden refused. Later the Swedes declared that this neutrality had saved the Allies from warring on Russia over Finland. In 1940 Sweden mobilized against possible invasion by Germany, but kept peace by trading with the Nazis. Sweden sent relief to occupied nations and took in many refugees.

In 1946 it joined the United Nations. It adopted the European Recovery Program but not the North Atlantic Treaty. King Gustavus V died in 1950. He was succeeded by his son, Gustavus VI Adolphus.

Sweden sent medical support to the United Nations forces fighting Communism in Korea. In 1953, after the armistice, Swedish citizens served on the Neutral Nations Repatriation Commission for war prisoners.

REFERENCE-OUTLINE FOR STUDY OF SWEDEN AND NORWAY

Location and size of Sweden and Norway S-461, N-300-2: location in world, map W-205; in Europe, maps E-416-17, 424; polar projection map P-346

SWEDEN

- **I. Structure of the land,** list S-461, maps N-301, E-419
  - **A. Mountains and plateaus** S-461, 462
  - **B. Rivers and lakes** S-462
  - **C. Coast line and islands** S-461: Baltic Sea B-37; Gulf of Bothnia S-461, 462; North Sea N-298
- **II. Climate** S-461-2, S-397: rainfall map E-420
- **III. People** S-55, S-461, picture S-462: Lapps S-462, L-101-2
  - **A. Farm life** S-462, 463-4, picture B-294
  - **B. City life:** Stockholm S-397; housing, pictures S-463, H-433
  - **C. Recreation:** skiing W-158; holidays and festivals S-464-5; (Gustavus Adolphus Day F-59) Christmas customs C-294*a*-*b*
- **IV. Resources and industries** S-462-3, S-397, list S-461, pictures S-461, 463, 464, 465
  - **A. Agriculture** S-462, 463-4: co-operative A-70
  - **B. Minerals and mining** S-462-3, map E-429*d*, picture S-464
  - **C. Lumber and products** S-462, picture S-461
  - **D. Water power** S-462, 463
  - **E. Manufacturing** S-462-3, S-397: co-operatives C-471; matches S-462, M-142
- **V. Trade, transportation, and communication** S-462-3, S-397: canals, picture S-465; shipping S-161, S-463, S-397. See also in Fact-Index Trade, table
- **VI. Principal cities** S-463, list S-461: Stockholm S-396-7
- **VII. Education, science, and the arts**
  - **A. Education** S-464, S-397: libraries L-183, 184-5; Uppsala University, picture S-464
  - **B. Science:** Carl von Linné L-254-5; Alfred Nobel N-242; polar exploration P-350, 351, list P-349, map P-346
  - **C. Literature** S-55, list S-421: Selma Lagerlöf L-87; Johan Strindberg (Fact-Index) See also in Fact-Index Scandinavian literature
- **VIII. Government** S-465
- **IX. History** S-465-6. For the detailed history of Sweden and relations with Norway and Denmark, see History of Scandinavia on the next page

NORWAY

- **I. Structure of the land,** list N-300, maps N-301, E-419
  - **A. Mountains, valleys, and plateaus** N-300-2, pictures N-299, 303, 304*b*: glaciers N-300
  - **B. Rivers and lakes** N-300, 302
  - **C. Coast line, fiords, and islands** N-300, 302, I-6, picture N-299: North Sea N-298

II. Climate N-302: rainfall map E-420
III. People N-299-300, 302, 304*a*, S-55, pictures N-304, E-415: Lapps L-101-2
   A. Farm life N-302, 304*a*, picture N-303
   B. Fishermen N-302, 304*b*, picture N-304*a*
   C. Recreation: sports N-304*a*, W-158; holidays and festivals N-302, F-58, 59; Christmas C-294*a-b*
IV. Resources and industries N-304*a-b*, O-426*b*, list N-300
   A. Agriculture N-299, 302, 304*a*: co-operative A-70
   B. Minerals and mining N-304*b*, map E-429*d*
   C. Lumber and lumber products N-300, 302, 304*a*, pictures N-303, E-415
   D. Water power N-300, 304*b*, picture N-303
   E. Fisheries N-299, 302, 304*b*, F-115, 117, picture N-304*a*
   F. Manufacturing N-304*b*, O-426*b*
V. Trade and transportation N-304*a-b*, O-426*b*, pictures N-299, 304: shipping, tonnage S-161
VI. Principal cities N-304*b*, list N-300: Oslo O-426*a-b*, pictures N-304; Bergen, picture N-304*a*; Hammerfest, picture N-304*b*
VII. Education, science, and the arts
   A. Education N-304*a*: libraries L-183, 184-5
   B. Polar exploration P-350-1, list P-349, map P-346: Roald Amundsen A-237-9, picture P-350
   C. Literature S-55: Björnstjerne Björnson B-202; Henrik Ibsen I-3; Johan Bojer, Knut Hamsun, Sigrid Undset (Fact-Index)
   D. Music: Edvard Grieg G-216
VIII. Government and religion N-304*b*-305, 304*a*
IX. History N-304*b*-305. For the detailed history of Norway and relations with Sweden and Denmark, see History of Scandinavia below

HISTORY OF SCANDINAVIA (SWEDEN, NORWAY, AND DENMARK)

I. General S-55, S-465-6, N-304*b*-305, D-70-2: rulers of Sweden, Norway, and Denmark, see tables in Fact-Index
II. Northmen (Vikings) N-294-7, picture A-187
III. Invasions of England E-358, 359, A-152: King Canute C-117
IV. Iceland and Greenland colonized I-11, G-214: Leif Ericson E-391, picture A-187
V. Haakon of Norway invades Scotland T-120
VI. Denmark wars with Hanseatic League H-260
VII. Union of Kalmar (1397) D-71, N-304*b*, S-465, S-55
VIII. Sweden revolts against Danish rule: Christian II and the "Stockholm Blood Bath" S-397, S-465
IX. Gustavus Adolphus and the Thirty Years' War G-233-4, T-118, E-432
X. Great Northern and Seven Years' Wars C-195, P-167, S-107
XI. Slave trade abolished (1792) S-197
XII. Napoleonic Wars N-8, 9: Sweden loses Finland (1809) F-72; Bernadotte founds dynasty and Norway falls under Swedish rule S-466, D-71, N-304*b*; Denmark retains Greenland G-214
XIII. Norway gains independence from Sweden (1905): Prince Charles of Denmark elected king as Haakon VII (1906) N-304*b*
XIV. World War II: Denmark and Norway occupied by Germany D-71-2, N-304*b*-305, W-249-50, 276; Sweden remains neutral S-466
XV. Iceland severs all ties with Denmark (1944) I-12
XVI. European Recovery Program and North Atlantic Treaty S-466, N-305, D-72

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SWEET PEA. No summer garden is complete without the fragrant many-colored blossoms of the sweet pea. Because of their beauty and fragrance and the ease with which they may be cultivated, these annuals are general favorites in greenhouses as well.

The sweet pea came originally from the island of Sicily. Father Franciscus Cupani, a monk and an enthusiastic botanist, described the plant in 1695 and sent seeds to England and Holland in 1699. By the last quarter of the 19th century, English growers had produced many varieties that combined beautiful colors with remarkable size. Americans found that California was ideal for growing the seeds. Today the California seed growers produce most of the world's supply, and the number of named varieties is very large.

The fragrant sweet pea is a favorite garden flower.

The sweet pea belongs to the pea family (*Leguminosae*). Its scientific name is *Lathyrus odoratus*. The blossom has five petals; the upper one is larger than the others and encloses them in the bud. The stem is rough and hairy; the seed pods, one to two inches long.

SWEET POTATO. As a table vegetable, the sweet potato ranks next in importance to the white, or Irish, potato (*see* Potato). It yields more pounds of food to the acre than any other plant and ranks next to corn in the amount of nourishment per acre. Although the sweet potato probably originated in America, China is the largest producer. Japan, Africa, the Republic of Indonesia, and the United States produce large quantities. More than half the United States crop is grown in the Carolinas, Georgia, Alabama, Mississippi, Louisiana, and Texas.

Unlike the white potato, it is a creeping perennial vine, related to the morning-glory, and its tubers are not underground stems but true roots. It is a more nutritious food than the white potato, being richer in proteins, sugars, fats, and vitamins.

The plant thrives best in a warm climate, but it can be grown wherever there is a growing season of four months free from raw winds and frost. The best type of soil for it is well-drained, loose, sandy loam. New plants are obtained by planting slips in hotbeds or in outdoor beds and by transplanting them about a month later. One bed will usually yield three sets of sprouts.

Sweet potatoes of the yellow-fleshed variety are called yams in the South, but the true yam is a root tuber belonging to a different family. It is grown in Asia, Europe, and the West Indies, but not to any great extent in the United States. The roots of some varieties weigh 30 pounds or more. The scientific name of the sweet potato is *Ipomoea batatas*. The yam is any one of several species of *Dioscorea*.

SWIFT, *the Unhappy* GENIUS *Who* CREATED GULLIVER

SWIFT, JONATHAN (1667–1745). When Swift wrote 'Gulliver's Travels', he intended it for a satire on mankind. He proposed, in his own words, "to vex the world rather than divert it." Instead, mankind, untroubled by the satire, enjoyed the story and gave it to children to read. Today most readers know this ferocious indictment of human nature only as an amusing tale for children (*see* 'Gulliver's Travels').


At 42 Swift was approaching the height of his career. He wears the fashionable 18th-century periwig and the clerical black gown with white bands.

Swift was born Nov. 30, 1667, in Dublin, Ireland. His parents were English. His grandfather, a vicar, had supported the Royalists during the Civil War and had lost all he owned.

From early youth, Jonathan Swift was bitter and resentful. Born a few months after his father's death, he was dependent upon an uncle who was, the boy thought, ungenerous. At six the orphan was separated from his mother. She went back to live in England while he was sent to Kilkenny School, "the Eton of Ireland," where he spent eight years. As a student he was not notable, and he seems to have made no close friendships. Nor was he either industrious or happy at Trinity College, Dublin, to which he was admitted in 1682. After taking his bachelor's degree four years later, he remained there three years more, though not quite long enough for a higher degree. Contemptuous of the subjects required of him, he devoted his time to reading history and poetry for his own pleasure, stayed away from lectures and chapel, and amused himself with companions in town.

Swift Seeks a Livelihood

England then ruled Ireland like a conquered province, and the English Swifts had recently come there to make their fortunes. The Revolution of 1688 made the English feel insecure, and Jonathan Swift left college the next year for England. Being a gentleman, he could not, by the old aristocratic code, go into business, and there was then no profession available to him. Through his uncle he was introduced to Sir William Temple, a retired Anglo-Irish statesman. Swift became a secretary to Temple and lived, with intervals elsewhere, at Temple's house for ten years.

Although Temple was kind to him on the whole, Swift could not forget that he was a dependent. His chief comfort in his galling situation was his friendship with a child, Esther Johnson, whose mother was companion to Temple's sister. When Swift first met Esther she was only eight, 14 years younger than he. He taught her to read and write, and as long as she lived she was his closest friend, known since to the world by the nickname Stella, which he gave her. Some students of Swift's life believe that they were secretly married in 1723, but they never lived together as husband and wife.

Clergyman, Wit, and Journalist

During the first years with Temple, Swift wrote a few poems which the poet Dryden, Swift's cousin, is said to have told him were not good—as they were not. Swift turned bitterly from writing poetry, which he did not think of as a profession. He might have become a lawyer or a soldier or might have had a minor post in a government office. Instead, he went to Ireland in 1694 and entered the Church of England. He was first sent to a rural parish near Belfast. This bored him, and he was soon back with Temple.

But now Swift knew he had a profession, and he was more assured about his future. Between 1696 and 1697 he wrote his first important satires, 'A Tale of a Tub' and 'The Battle of the Books'. He did not publish them, however, until 1704.

Temple's death in 1699 made Swift return to Ireland, and Stella soon followed him. Again Swift was assigned to a country vicarage. It was a small parish, and the story is told that once when the sole member of the congregation was his own curate, Swift began the service: "Dearly beloved Roger—:" He was free to leave his parish in charge of a curate and spend much of his own time in Dublin or London.

CARTOONS FOR SWIFT'S SATIRE

These cartoons are by George Cruikshank, for the 1843 edition of Swift's 'Martin's Vagaries'. Both book and pictures satirize religious differences.

As a clergyman he regarded himself more or less as a soldier holding a garrison against the enemy. But when there was no immediate danger, or when there was work to be done elsewhere, he did not hesitate to turn his post over to subordinates. What took him to London was a mission from the Irish Church to obtain benefits from Queen Anne. What kept him there was partly his duties as lobbyist, partly his efforts to obtain a higher appointment in the church for himself, and partly his friendship with the wits of London, where 'A Tale of a Tub' made him quickly famous. Addison and Steele were close companions. He wrote papers for *The Tatler* and took part in hoaxes that made all London laugh.

Heretofore Swift had been, like Steele and Addison, a Whig. But in 1710 he went over to the Tories, chiefly because he thought they had the interests of the church more at heart than the Whigs had. This led to his employment by the Tory ministry which had just come into power. The chief aim of the Tories was to end the long war with France, which had been undertaken by the Whigs and waged by their great general, Marlborough. The Tory ministers set themselves to destroy Whig power, get rid of Marlborough, and bring peace. They managed the necessary political intrigues and used Swift to influence public opinion by his writings.

An Anonymous Pamphleteer

In the Tory *Examiner* and in pamphlets and verse he carried on a blasting campaign against Marlborough for his greed and against the Whigs for their fanatical refusal to consider the interests of Britain as a whole. In all this Swift wrote anonymously. He wanted to win his point, not serve his personal reputation. He no more cared what became of such writings after they had done their work than a hunter cares what becomes of his bullets after they have brought down his game.

Alienated by politics from Addison and Steele, Swift now made new literary friends among the Tories: the witty and spiteful Alexander Pope; John Gay, author of 'The Beggars' Opera'; and John Arbuthnot, physician to Queen Anne. With some others they formed the Scriblerus Club which met every Saturday night. Together they planned to write the burlesque memoirs of the imaginary Martinus Scriblerus, to ridicule false learning. Though this was barely begun and outlined, it was the seed of 'Gulliver's Travels'.

Marlborough was recalled and the war ended with the treaty of Utrecht in 1713, but the Tory ministry did not last. After the Queen's death in 1714 the Whigs regained their power, under the Hanoverian King George I. Swift throughout his period of influence had hoped he might become a bishop. But he had too many enemies, and his friends did no more than make him dean of St. Patrick's Cathedral in Dublin.

During these years of daily association with the great, Swift sent Stella in Dublin a day-by-day account of everything he did. This 'Journal to Stella', written with no thought of publication, is a fascinating record not only of Swift's life but of London society and politics in the reign of Queen Anne. It remains one of the great personal diaries in all English literature.

Exile and Patriot

Although Swift is now thought of as one of the supreme Irish patriots—and was—he returned to Ireland as to a place of exile. London had been the scene of his successes. The men he liked best were there. In Ireland he was out of the world in which he had come to feel at home. Dublin had no poets like Pope,

no wits like Arbuthnot. For ten years Swift took almost no interest in anything. His one confidante was Stella, who with a companion lived always near him.

When he emerged from his silence it was again as an enemy of the Whigs. But now he attacked the Whigs as Englishmen misgoverning Ireland. In 1724 he wrote his 'Drapier's Letters', rallying the Irish with arguments that sometimes anticipate those later used by the American colonists before the Revolution. In 1729 he published the most terrible of his satiric pamphlets, 'A Modest Proposal'—that the people of Ireland eat their children as the only way to keep England from starving them all to death. And so for the rest of his life he defended the Irish cause with a force and wit that went a long way to uniting Ireland.

After 1720 Swift again took up the Scriblerus memoirs which he and his friends had planned in London, and by 1725 he had finished 'Gulliver's Travels'. The next year he visited London, where he had the happiest time with Pope, Gay, and Arbuthnot, and where he left his book to be published. Because of the political satire in it, the manuscript was sent secretly to the printer, and the book appeared without Swift's name. But it was known to be his, and it instantly became popular. In 1727, he visited London again. Thereafter he lived in Ireland, often homesick for England but gradually settling himself into a life which had turned out better than he expected. After Stella's death in 1728 he was very lonely, in spite of his devoted friends. He had suffered since his young manhood from attacks of deafness and giddiness. These became worse, and finally unendurable, and for the last three years of his life he was insane. He died Oct. 19, 1745, and was buried in St. Patrick's beside Stella. Over his grave was carved the epitaph he wrote for himself, with the famous line: *Ubi saeva indignatio ulterius cor lacerare nequit*—"Where furious indignation can no longer eat into the heart."

'Gulliver's Travels'

'Gulliver's Travels' (1726), one of the most famous of books for children, was not written for children at all. It was savage satire aimed at the entire human race. Swift was more than a merely disappointed man. By nature morbidly fastidious, he had an instinctive antipathy to mankind at large because of its vice, folly, stupidity, and uncleanness. His 'Gulliver's Travels' was his arraignment of the world.

The strange countries which Gulliver visits were, for Swift, much like the countries he knew. The tiny Lilliputians are as vain, malicious, and bloodthirsty as ordinary men. Readers of the book in Swift's day saw in the king and the court of Lilliput a parody of the English king and court. The giants of Brobdingnag are amiable, but they are commonplace and insensitive. Laputa is full of the foolish philosophers and scientists that Swift despised. And the Houyhnhnms are horses who use degraded men, Yahoos, as men use horses elsewhere. This fourth voyage of Gulliver marks the peak of Swift's satire. Looking at mankind through the eyes of horses, he sees it as vicious, greedy, ignorant, and filthy. Beasts are better.

'Gulliver's Travels' from its first appearance delighted the world instead of shocking it. The satire was lost in the story. In spite of his misanthropy, Swift took a dry delight in making his narrative so circumstantial that it would sound real even when it was most fantastic. Adults might catch the cold implications of the book, but children, quite unaware of them, could breathlessly enjoy the marvelous adventures of a traveler among pigmies and giants, on a flying island, in a topsy-turvy country where horses talk. 'Gulliver's Travels' was soon a classic for children, and has been that ever since. This has had an ironical result. Most people, having read the book in childhood when the satire meant nothing to them, do not know there is anything in it but the story.

Other Writings

Swift was a very great writer who usually wrote to affect public opinion at the time. A large part of what he wrote is made up of pamphlets on political or ecclesiastical affairs, and must be read in the light of history. But 'A Tale of a Tub', a satire on false religion, and 'The Battle of the Books', a burlesque of literary controversy (both published in 1704) are still read for their comic ridicule of human folly. In his 'Drapier's Letters' (1724), written to expose a minor scandal in the government of Ireland by the English, Swift lifted the issue to something universal, the human rights of men against tyrants. In 'A Modest Proposal' (1729) is a voice speaking for an outraged nation. Swift seems often to have done more than he knew he was doing. The 'Journal to Stella' is only a diary written for a friend, but it is also a brilliant picture of London in one of its brilliant ages. The 'Verses on the Death of Doctor Swift' (1739) he wrote as a kind of joke, to tease his friends, but it is almost unbearably heartbreaking. It is laughter and anguish in the simplest speech.

Both in verse and prose Swift's chief qualities are intensity and directness. A man of vehement emotion, he had absolute lucidity of mind. Nothing that he wrote is ever cloudy or feeble or flat. The force of a burning poet is behind his words, but the words themselves are plain and blunt. In the contrast lies the secret of his power.

Editions and Biographies

The best collected edition of Swift is that of the prose in 12 volumes edited by Temple Scott (Macmillan, 1897–1908) with two additional volumes of verse edited by W. E. Browning (1910), now out of print. Good editions of individual works are: 'A Tale of a Tub' (Columbia Univ. Press, 1930, edited by Edward Hodnett); 'The Drapier's Letters' (Oxford, 1935, edited by Herbert Davis); 'Poems' (3 vols., Oxford, 1937, edited by Harold Williams); 'Gulliver's Travels' (Heritage, 1940). Volumes of selections are: 'Portable Swift' (Viking, 1948, edited by Carl Van Doren) and 'Satires and Personal Writings' (Oxford, 1932, edited by W. A. Eddy). The standard biography by Sir Henry Craik (1882) is now out of print. The following studies by H. J. Davis are also valuable: 'Stella: A Gentlewoman of the Eighteenth Century' (Macmillan, 1942) and 'The Satire of Jonathan Swift' (Macmillan, 1947).

The Most POPULAR *of* WATER SPORTS

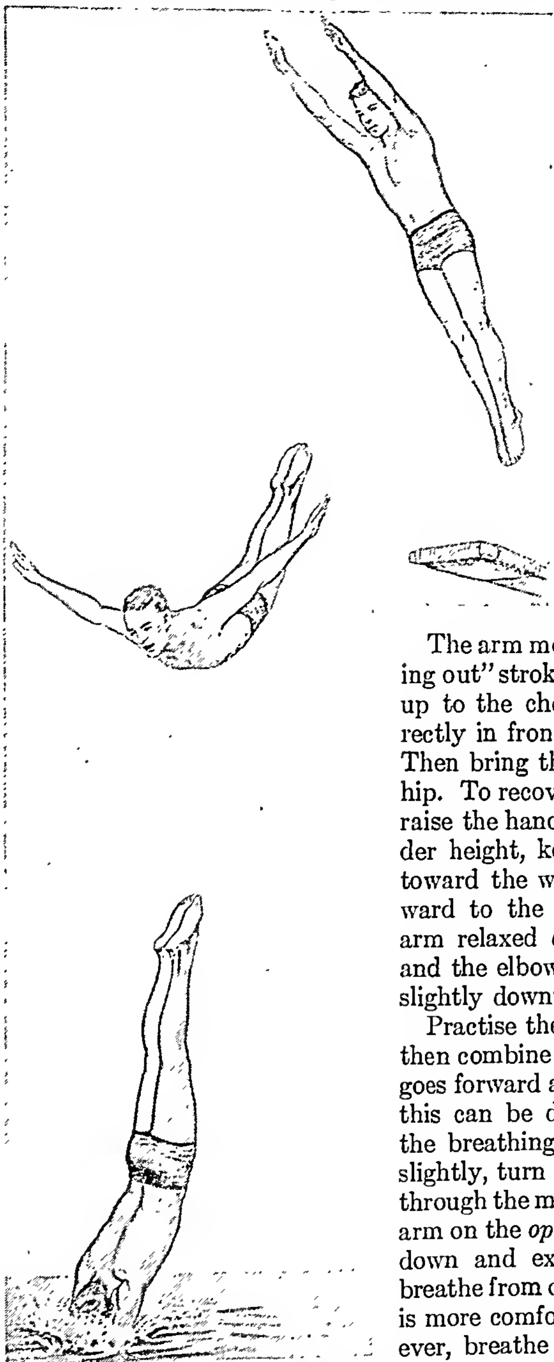
SWIMMING. Unlike many living creatures, man does not swim by instinct. Yet he can learn to swim better than almost any land animal. He need only master the proper strokes and ways of breathing.

Human beings can learn to swim for this reason: when the average human body has air in the lungs, it is slightly lighter than fresh water and much lighter than salt water. Nearly everyone can *float* motionless on the back with only the face above water. The body need only be properly balanced along the surface to provide buoyancy. Many people are drowned because they become panicky and thresh about in the water. A good swimmer lets his body float and moves forward with arm and leg motions.

Learning to Swim Step by Step

The most important task is learning to breathe correctly. Swimmers inhale through the mouth. They exhale through either the mouth or nose or both. Coaches often instruct pupils to inhale deeply and quickly but to exhale more slowly.

To practise breathing, wade into water waist-deep. Inhale through the mouth, put hands on the knees, and bend forward until the face is submerged. Count ten while holding the breath, lift the head and exhale. Repeat until the breath can be held for a count of 15. Next practise exhaling under water, keeping the eyes open and watching the bubbles. To inhale, turn the face to one side, bringing the mouth above the water.



This drawing shows the chief parts of a swan dive: (1) take off from the springboard; (2) flight through the air; and (3) straightening out for entry into the water.

The next step is learning to *coast* through the water. Go out hip deep, face the shore, and stoop down with arms extended beyond the head. Shove vigorously with the feet and float as far as possible. To take a breath, push down with the hands, raise the head, and drop the feet to the bottom. Learn to coast 15 feet or so, breathing out under water. Anyone who can do this is ready to learn the crawl, the fastest and most useful of all strokes.

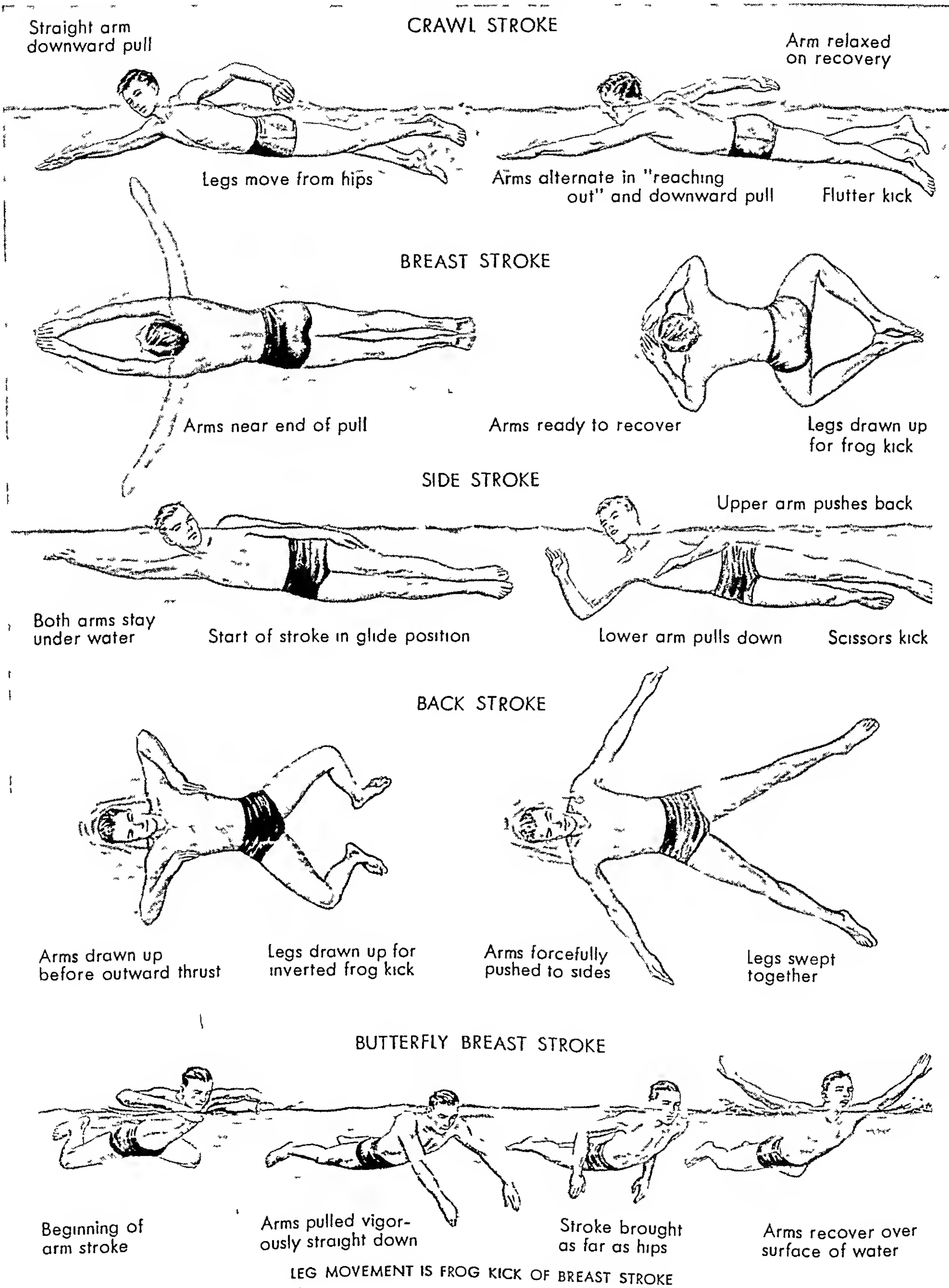
The Crawl. Start in water deep enough so that the head is held above water when the palms of the hand are on the bottom. Extend the body backward and kick the legs slowly up and down from the hips. Keep the toes turned inward (pigeon-toed) and the knees straight but relaxed. Increase the speed to an even rapid threshing (flutter kick). Then go out farther into the water and plunge toward the shore, with arms extended and the legs threshing. Repeat until you can keep afloat for several yards.

The arm movement is an alternate "reaching out" stroke. Practise it standing in water up to the chest. Extend the right arm directly in front of the shoulder, palm down. Then bring the hand straight down to the hip. To recover, turn the palm outward and raise the hand upward and forward to shoulder height, keeping elbow bent and thumb toward the water. Then reach straight forward to the starting position. Keep the arm relaxed during its forward movement and the elbow high so that the hand points slightly downward. Then repeat the stroke.

Practise the same motion with each arm; then combine the two movements. One arm goes forward as the other comes back. When this can be done in perfect rhythm, learn the breathing "movement." Bend forward slightly, turn the face to *one* side, and inhale through the mouth during the recovery of the arm on the *opposite* side. Then turn the face down and exhale under water. Learn to breathe from one side or the other, whichever is more comfortable. Most swimmers, however, breathe from the left side during the recovery of the right arm.

Now go out into the water waist-deep and plunge toward shore while keeping up the arm movement. The back should be straight and the head held high with eyes at about the water line. As soon as the arm stroke becomes natural and easy, add the leg movement. Start the kick as soon as the feet are off the bottom and then add the arm stroke. Make six kicks to each complete arm stroke, counting one-two-three to the down pull and four-five-six to the recovery. Most fast swimmers use the "six-beat" crawl, but some make four, eight, or ten kicks to every double-arm stroke.

THE MOST POPULAR SWIMMING STROKES



The Side Stroke. This stroke is made while lying on either side. The arms are pulled back alternately without the hands leaving the water. The leg motion is a *scissors kick.* Draw the legs up slightly, keeping them close together; then extend the upper leg forward and the lower leg backward and bring them together vigorously. The *single overarm* is the same stroke, except that the upper arm reaches forward above the water while the body makes a quarter roll.

The Breast Stroke. In this stroke the body lies breast down. Extend the arms in front of the head, palms touching, fingers closed. Hold the legs straight, heels together and toes pointing slightly to the sides. For the arm stroke, turn the palms outward and sweep the arms backward on a line with the shoulders. Then bring the hands together under the chin and thrust them forward. During the arm recovery draw up the legs with the knees bent and spread. Then kick out into a V position and press the legs vigorously together. This motion is called the *frog kick.*

The *butterfly* used chiefly in racing is adapted from the standard breast stroke. Both arms are lifted out of the water and extended, palms down, ahead of the body. The arms are then pulled vigorously, straight down under the body to the hips. The leg movement is the frog kick of the breast stroke.

The Elementary Back Stroke. Lie on the back, body straight but relaxed. Draw the hands up along the sides to the armpits, palms in. Thrust the arms outward at shoulder level and then sweep them to the sides. Draw up the legs while the hands are at the armpits and frog kick as the arms sweep inward.

Diving. This is an art which requires constant practise. For plain diving, hold the hands over the head with thumbs together and palms down. Then jump from a slight crouch, sending the body on a curved path similar to that of a stone tossed out the same distance. The body should enter the water straight, arms ahead and toes pointed backward. To bring the head quickly to the surface, bend the hands upward at the wrists when the body is about halfway in the water.

The position of the head determines the flight of the body through the air and entry into the water. If the head is carried too far back the body will strike the water flat. If the head is "ducked" the diver tends to turn over too far. To jump into the water feet first, hold the nose closed. Otherwise water will be forced into the nasal passages.

Lifesaving. Everyone should learn to rescue a drowning person. One motto is "Throw, tow, row, go." First, if the victim is close to shore *throw* him a board, rope, or ring buoy and then *tow* him to safety. Second, if there is a boat handy, *row* out to him. Third, *go* to him only if you are a strong swimmer with some lifesaving practise.

One method of rescuing by swimming is: From the rear, pull the victim by the chin to a level position. With the other arm, reach over his shoulder and grasp him across the chest; balance the small of his back on your hip. Use the free arm to swim a modified side stroke—a shallow arm pull and inverted scissors kick.

SWINBURNE AS A YOUNG MAN

One of the most musical poets of the 19th century was a distinctive and striking figure. His large head, with its mass of flaming red hair framing a little pallid face, surmounted a small and slender body.

Swinburne, Algernon Charles (1837-1909). Into the midst of staid Victorian England burst a red-haired young man with new ideas and new poems. Young Swinburne's ideas defied the conventions of his time, but his poems contained a wealth of language and enchanting melodies. By the time he was 30, he was already famous, and his 'Atalanta in Calydon' and 'Songs and Ballads' were widely discussed.

Swinburne was born in London, April 5, 1837. His father was Adm. Charles Swinburne and his mother was Lady Jane Henrietta, a daughter of George, 3d earl of Ashburnham. As a child Algernon lived on his father's estate on the Isle of Wight and at his grandfather's home in Northumberland. He went to Eton College at 12 and remained there five years. Slight and frail, he took no part in sports but read avidly.

At 19 Swinburne entered Balliol College, Oxford. Here he knew Dante Gabriel Rossetti and Rossetti's circle of Pre-Raphaelites. He shared their love for medieval studies, but his own taste in literature had already formed. Readings that influenced him most were the Bible, Greek drama, Shakespeare, and Hugo.

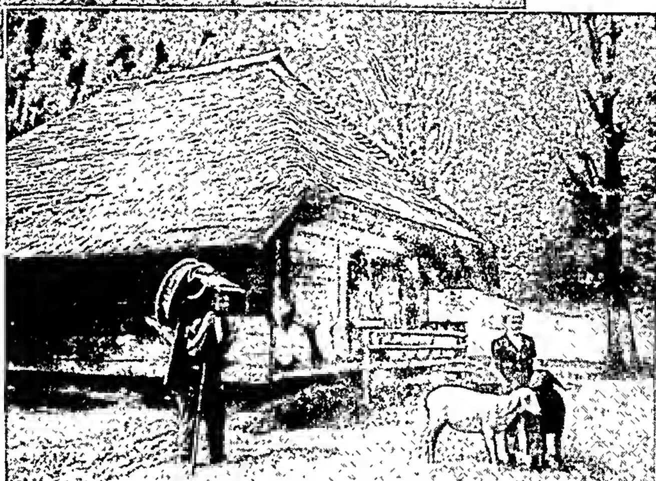
After three years Swinburne left Oxford to write in earnest. In 1860 he published two poetic dramas, 'The Queen Mother' and 'Rosamond', which attracted little attention. 'Atalanta in Calydon' (1865) and the first series of 'Songs and Ballads' the following year established his reputation.

Italy's struggle for freedom inspired 'Song of Italy' (1867) and 'Songs before Sunrise' (1871). In 'Erechtheus' (1876) the poet returned for inspiration to ancient Athens. In 1879 he published another series of 'Songs and Ballads' and 'A Study of Shakespeare'.

Repeated attacks of epilepsy finally broke Swinburne's health. In 1879 he moved to the home of Theodore Watts-Dunton, where he spent his last 30 years in retirement. In these years he still wrote much in prose and verse.

Swinburne was a poet, not a teacher. His contribution to literature consists chiefly of his incomparable lyrics. His mastery of metrical forms assures his place among the great poets of his day.

LIFE *in the* MOUNTAINS *of* SWITZERLAND



Here we see how the Swiss in the Alpine valleys have learned to make a living by farming. In summer they drive their cows to the high pastures (top picture). The herdsmen make cheese from the milk. They carry the cheeses down to the valley villages in racks, called "hirds" (center). A farm family will take old-fashioned scythes and rakes to harvest the hay on rocky meadows to help fill out the supply of winter feed (bottom).

SWITZERLAND. The Alp Mountains fill most of Switzerland and make it one of the most beautiful countries in the world. Thousands of tourists come every year to see the snow-draped peaks and glistening glaciers, the sparkling lakes and waterfalls, and the quaint villages and valleys.

But the mountains also make it difficult to travel or transport goods, to earn a living by farming, or to develop industries. And they do not provide coal or raw materials for manufactures. But the Swiss have overcome their handicaps better than any other mountain people.

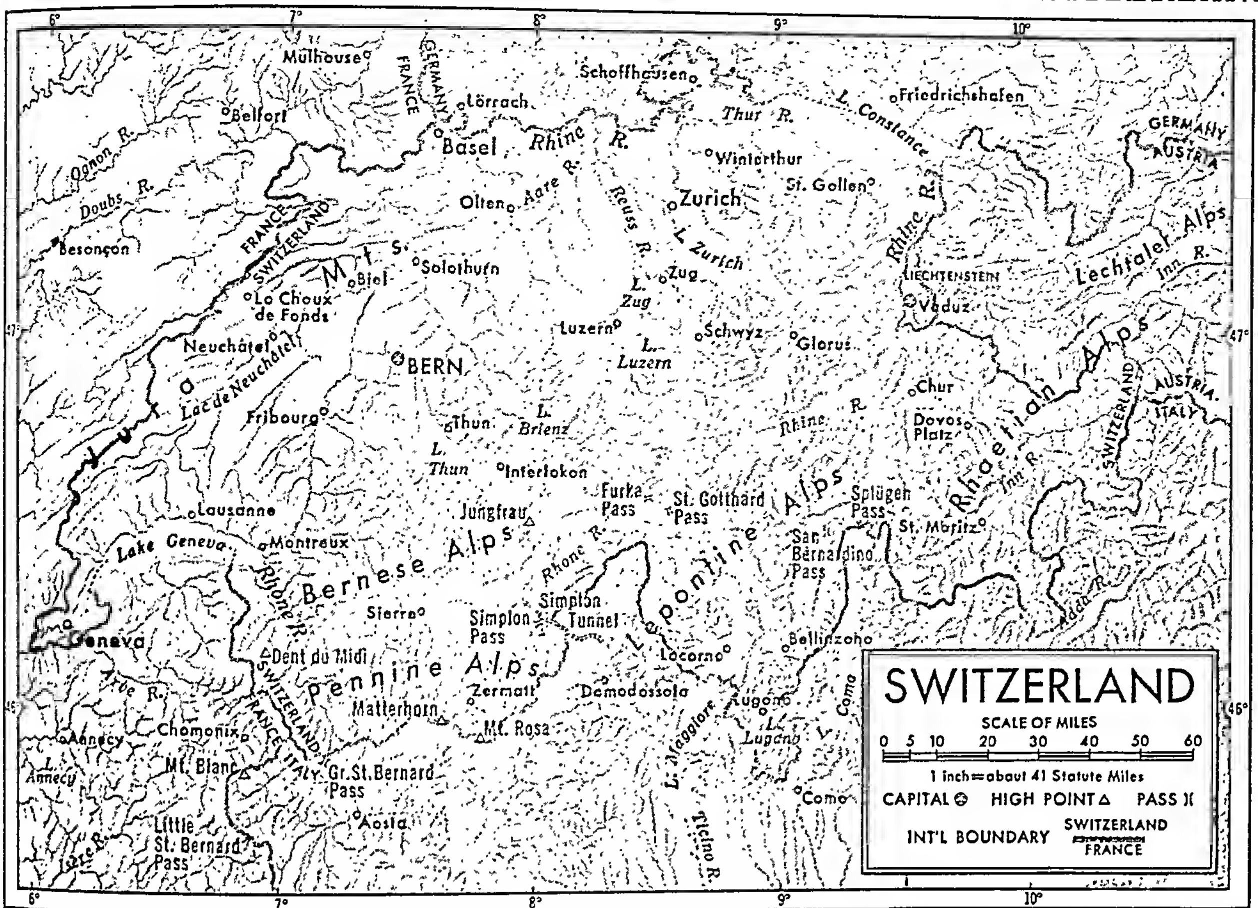
By patient, hard work they keep dairy cattle and grow crops on every patch of good land. Their engineers have built amazing roads and railroads through the mountains. They get electricity for the towns and factories by harnessing mountain rivers. They work patiently and skillfully to make valuable products like watches and lace. And they sell these products to pay for all the imported materials they need. Although the country has no seaport, the Swiss have developed a large world trade.

Farming on High Mountain Land

More than a fifth of the Swiss make their living by farming. The best farm land is on the broad plateau between Lake Geneva and Lake Constance. But even this land would seem hilly and rocky to American farmers. In the mountains the land is too steep for plows or farm machinery, and the high altitude makes the growing season short and cool. Yet the Swiss work farms in the high mountain valleys. They succeed by putting everything around them to good use.

They build houses called *châlets* close together in little villages to save space. The houses may be three or more stories high and hold several families. The builders use mountain stone for the lower walls, and timber from near-by forests for the upper parts. They make the roofs steep to shed summer rain and winter snow. In winter, the Swiss stable cows and sheep in the lowest story. This keeps the animals warm, and the family can tend them without going out into deep snow.

The farmers plant potatoes, vegetables, root crops, and barley



Lofty Alpine ranges cover the southeastern half of Switzerland. Along the French border in the northwest the Jura Mountains rise steeply. Between them lies a rolling plateau cut by the broad valleys of the Aare and Thur rivers.

in fields no bigger than a small room. They cannot spare space near the villages for pasturing animals, so in summer they drive their flocks and herds to graze on meadows called "alps" high up in the mountains.

When the herdsmen and animals leave in May, each village holds a festival. (In German it is called *Alpaufzug*, meaning "move to the meadow.") Everyone dresses in old-fashioned costumes, and the "queen" cow wears a wreath of flowers. The villagers go a mile up the steep trail with the herdsmen, boys, and animals. Then they bid them goodbye for the summer.

The cattle go from one high meadow to another, moving farther and farther up the slopes as the snow melts. Finally they reach heights where it is too cold and windy for trees. But juicy grass grows above the tree line, and Alpine flowers bloom at the edge of the snow on the high peaks. The Swiss national flower, the edelweiss, grows on icy ledges. Where the land is too steep for cattle, or the grass is too thin, the herdsmen pasture sheep and goats.

The herdsmen live in huts made of logs or stone. They weight the roofs with rocks to keep them from blowing away in the high winds. They make cheese from the milk they get. Now and then a man carries a big cheese down to the village and climbs back with supplies.

When the herds come back at the end of summer the villagers divide the cheese. Each family keeps enough for winter use and sells the rest. Swiss farmers eat cheese instead of meat because they cannot afford to slaughter their dairy cattle. In winter they may sell their milk to a factory that makes cheese, condensed milk, or milk chocolate. Sometimes they hitch big dogs to a sled or a cart to haul the milk.

Before the weather gets too cold, some of the men go to the community forest to get firewood. The Swiss take good care of their forests and plant new trees to

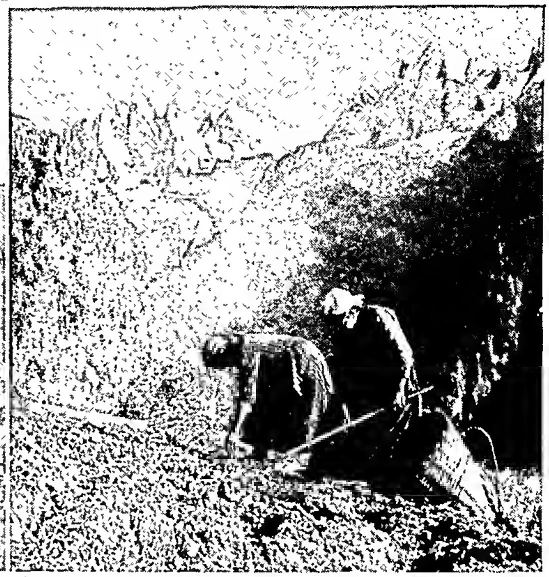
Extent.—Southwest to northeast, 226 miles; south to north, 137 miles (45° 49′ and 47° 48′ 30″ N. latitude, and 5° 58′ and 10° 30′ E. longitude). Area, 15,944 square miles. Population (1950 census), 4,714,992.

Natural Features.—Massive ranges of Alps in southeastern two thirds; Jura Mountains on west, and rolling to hilly plateau between them. Highest peak, Monte Rosa (15,217 feet). Chief lakes: Constance, Geneva, Neuchâtel, Zurich, Zug, Luzern, Thun, Brienz, Maggiore, Lugano. Chief rivers: Rhine, Rhone, Aare, Thur, Reuss, Inn, Ticino.

Products.—Dairy products; hay, wheat, rye, barley, oats, potatoes, hardy vegetables and fruits, grapes; cattle, hogs, goats, sheep; lumber, salt; watches and clocks, machinery, textiles, electric equipment, chemicals, shoes and other leather goods, cheese, condensed milk, milk chocolate, wine, paper and printing.

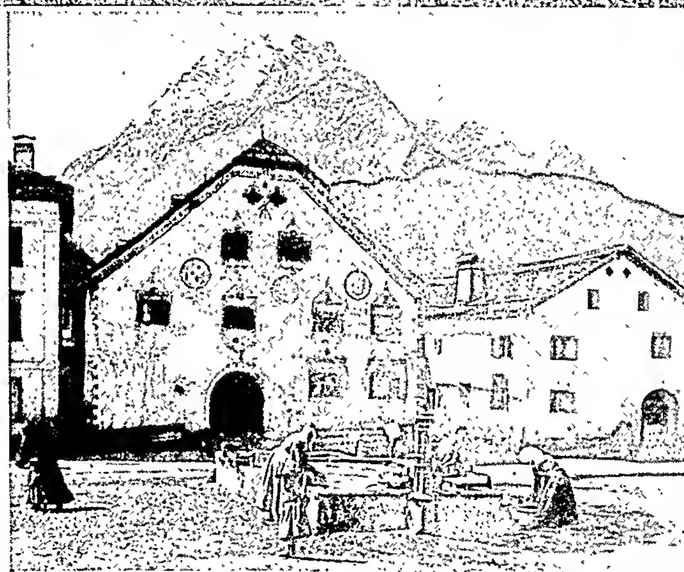
Cities.—Zurich, 390,020; Basel, Bern (capital), Geneva, Lausanne, more than 100,000; St. Gallen, Winterthur, and Luzern, over 60,000.

HARD WORK IN ALPINE MEADOWS AND VILLAGES



replace the ones they cut. The ground beneath the trees holds water well and helps prevent floods from rain in summer and melted snow in spring. The trees also help to keep snow from sliding down the mountain slopes in destructive avalanches (*see* Avalanche).

When winter ends most of the farm work, the Swiss turn to indoor tasks. The men and boys carve toys and other objects from wood, and make light metal articles. The women and girls spin and weave wool from their sheep and make fine embroidery and lace. In some towns, factories send materials to the homes, and the families do delicate handwork on articles such as watch movements.



It takes hard work and careful use of all crop land to live in the Alps. Farmers carry hay from the high meadows in nets to save every wisp (upper left). Women hoe tiny potato patches on rocky, sloping land an American farmer would not use (upper right). In the Engadine Valley village (bottom), housewives are doing their washing at the public fountain.

How Swiss Manufacturing Grew

Through their homework the Swiss became skillful with their hands. This helped greatly in developing the country's manufacturing. Manufacturers specialized in articles that needed little material and much skill. For example, from a small amount of imported steel and gold, they make expensive watches and clocks.

Another help has been ample water power. In older times the Swiss built factories beside rushing mountain rivers and streams and used waterwheels. Today they send the falling water through turbines to generate electric current. In this way they make up for not having coal to furnish steam power.

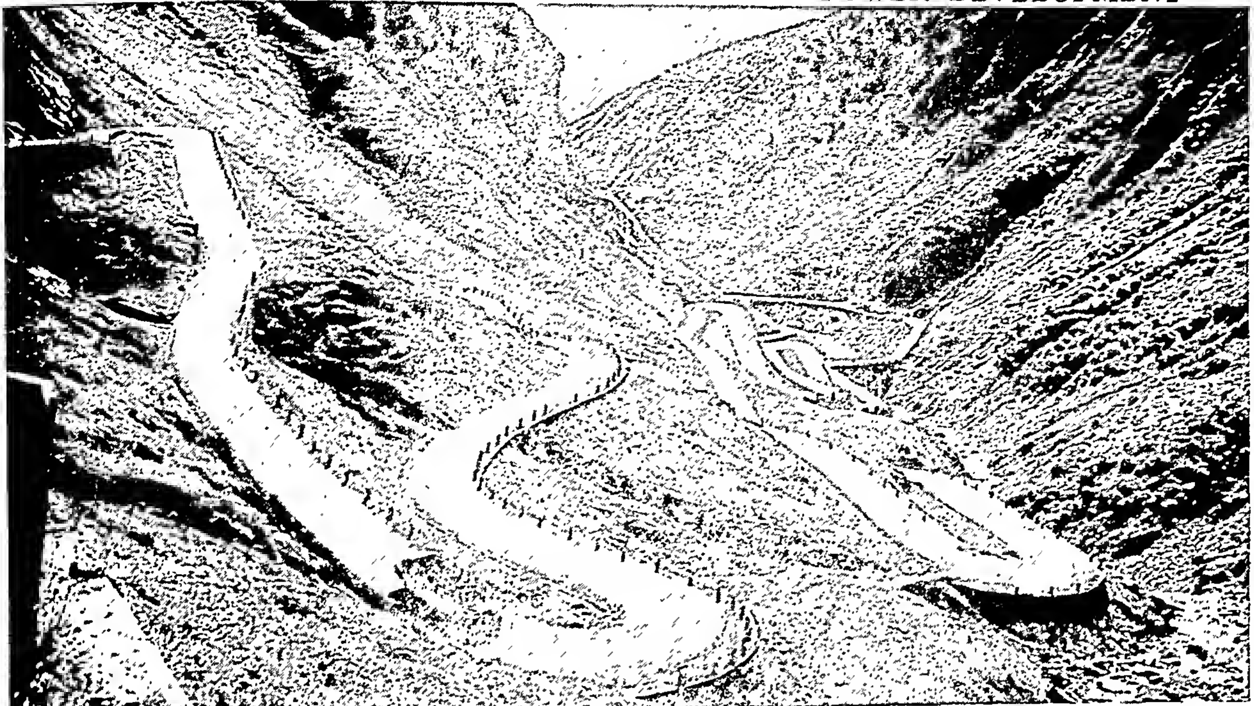
The Swiss sell manufactured goods to pay for goods they must buy abroad. In addition to watches and clocks, they export music boxes, scientific instruments, rayon, machinery, drugs and chemicals, fine cloth, ribbons, embroidery, and lace. They import foodstuffs, cotton, silk, linen, metal, and coal and oil. Most of the factories are in towns on the Swiss plateau.

Tourist Business and Transportation

The tourists spend large sums of money in Switzerland, and the Swiss do all they can to attract visitors. They keep fine hotels and world-famous resorts. Many of the resorts are for summer visitors, but others specialize in winter sports.

The Swiss locate their hotels where they will have beautiful views. Thousands of people make a living serving the tourists. They learn to speak the languages of their guests and to cook their favorite foods. Experts at winter sports set up ski runs, toboggan slides, and skating rinks to attract winter guests. Skilled mountaineers guide people who want to climb the rocky peaks. Cable or cogwheel railways carry people up to many famous summits. The Swiss also maintain sanitariums where the sick can have the benefit of mountain air and sunshine.

ENGINEERING FEATS IN ROAD BUILDING AND POWER DEVELOPMENT



This stretch of the famous St. Gotthard highway shows how Alpine roads twist and turn to reach the high passes. A road straight up to the pass would be much too steep. The twists and turns spread the climb over a much greater length of road.

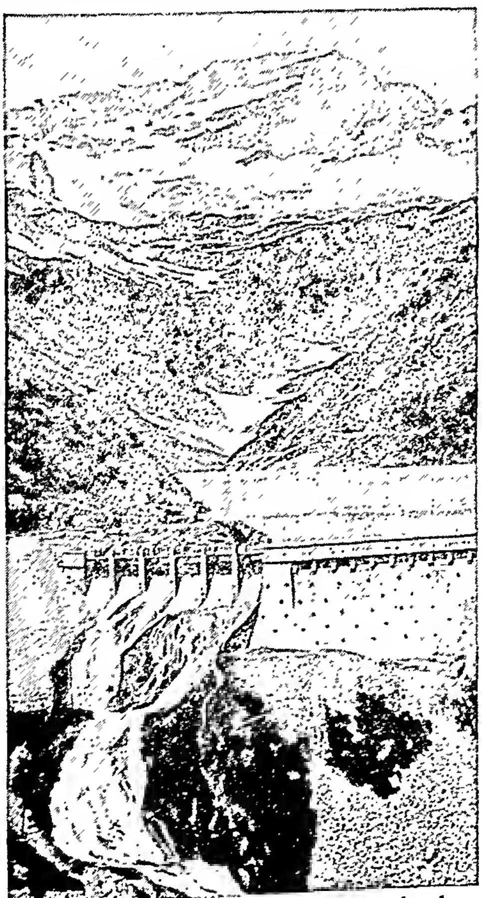
They also have fine roads and railroads to carry tourists as well as goods. Construction is extremely difficult and costly. Each route follows a valley until it must cross a mountain range. Then it may zigzag up a mountainside toward a low spot, or *pass*, on the crest of the range. But the pass may be so high it is often choked with snow. Therefore the engineers have blasted tunnels under many of the passes for the railroads.

Nature and Use of the Land

MAPS of Europe show that Switzerland is small indeed. Its 15,944 square miles make it about as large as Massachusetts, Connecticut, and Rhode Island.

The relief map in this article shows three natural divisions, running from southwest to northeast. The Alps fill two-thirds of the land. They extend from France on the southwest into Austria and Germany on the northeast, and into Italy on the south.

A lower range of mountains, the Jura, rises in the northwest between Switzerland and France.



This dam is part of the huge Swiss power development system. Built in a narrow valley, it holds back the flood of water that melts from the snow-clad peaks in spring. Then throughout the year the water is allowed to flow through the turbines of a power plant, generating electricity.

Between the Jura and the Alps lies the third region, a hilly plateau. It extends from Lake Geneva on the boundary of France, to Lake Constance, where Switzerland meets Austria and Germany.

The most important river in Switzerland is the Rhine. If we trace its course upstream, we find it lying like a giant fishhook. The "eye" of the hook is at Basel, where the Rhine starts flowing north between France and Germany. The shank runs east to Lake Constance. Then the bend cuts through the Alps to the headwaters near St. Gotthard Pass. Beyond the pass is the source of another great river, the Rhone. It flows to Lake Geneva and from the lake into France. Most of the plateau is drained by a tributary of the Rhine, the Aare.

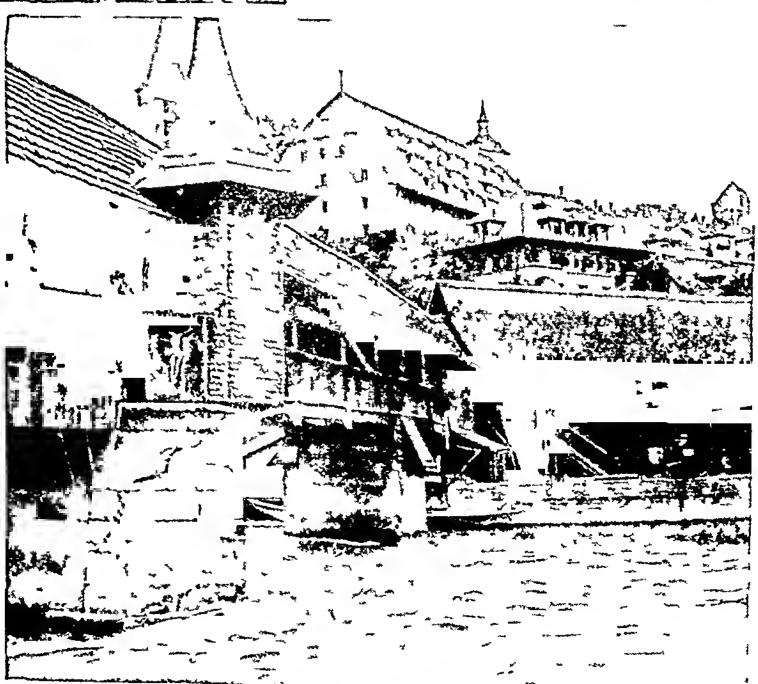
The Mountains Make Climate

Switzerland lies in the same latitude as northern Maine. It receives rain-bearing winds from the Atlantic, and the south slopes of the Alps get winds from the Mediterranean. But the mountain system is the greatest climate-making factor.

INSPIRING SIGHTS FOR TOURISTS

Temperature falls one degree for every 300-foot rise in altitude; and the Alps are high enough to provide a range of climate from warm to frigid. The warm region is at the foot of the Alps in the southeast around Lake Maggiore. The altitude is 600 feet, and the mountain barrier blocks cold winter winds coming from northern Europe. The climate is fine for grapes and other fruit. Within a few miles the Alps rise more than 10,000 feet, and they have ice and snow even in midsummer. The snow line, or altitude at which snow never melts, comes at heights between 8,000 and 10,000 feet, depending upon exposure to wind and sun. The heights often create local winds—a raw, cold one called a *mistral*, and a warm one called a *foehn* (*see* Winds).

On the plateau the altitude is from 1,000 to 2,000 feet, and winters are long and frosty. The cool summer temperature reaches an average of 65 °F. in July, and this is ample for grain. Most of the country's crops grow here.



A famous Swiss sight is the snow-draped pyramid of Mount Matterhorn towering above Zermatt (top picture). The lower picture shows one of the quaint old bridges that cross the river Reuss at Luzern.

In the surrounding mountains, forests of beech, oak, and chestnut grow up to about 4,000 feet, and hardy crops ripen. Above this height, only evergreens thrive. The timber line (upper limit for trees) is about 7,000 feet. From here to the snow line, only grass and Alpine flowers grow.

Snowfall and rainfall increase with altitude. Precipitation on the plateau is from 35 to 40 inches a year. Higher slopes may get 90 inches in a year.

Life in the Jura Mountains

The Jura Mountains resemble North America's Appalachians. They are limestone ridges with summits seldom higher than 5,000 feet. Transportation routes follow the valleys and pass the crests through gaps cut by streams or through tunnels. Forests reach the summits and provide abundant timber. The rugged land and raw, moist climate serve dairying better than crops. Many dairy farms produce milk for cheese and milk chocolate factories.

Swiss watchmaking is centered in this region. The industry began, as we have seen, as winter homework for skillful mountain farmers. Today, factories in La Chaux de Fonds, Neuchâtel, and Le Locle make most of the Swiss watches and clocks.

On the Swiss Plateau

The plateau is not only the best farming land, it has most of Switzerland's rich

industries. Here live 70 per cent of the Swiss. All the great cities are here except Basel (Basle), which is in the Rhine Valley beyond the Jura.

The glaciers of the Ice Age helped to form the plateau. At that time huge masses of ice pushed down the Alpine valleys and out on the plateau. They carried the glacial drift that made the soil. When they melted, the debris they left blocked valleys and created basins for beautiful lakes at the base of the Alps. The largest lakes are Geneva and Constance on the borders and Neuchâtel at the base of the Jura. Smaller lakes noted for their mountain-rimmed beauty include Zurich, Zug, Luzern (Lucerne), Thun, and Brienz. Streams rushing down from the mountains have furrowed the land into broad valleys with rounded ridges between them.

Farms cover the best land of the plateau. The ridges bear forests of oak and pine. Rye, oats, wheat, potatoes, root crops, vegetables, tobacco, and hay grow in carefully tended fields. Cattle are raised everywhere. They are mainly fed in barns because no cropland can be spared for pasture. Many farmers ship young stock to the mountain pastures in summer. Apple trees border the roads. Vineyards and orchards flourish on south-facing slopes.

Industry, however, is far more important than farming, and most of the people live in towns and work in factories and businesses. The northeast is the richest industrial section of the plateau. Textile and machinery industries are located throughout the northeast, around Zurich, the largest city. Basel, the second city, leads in the manufacture of chemicals. Bern, the capital, is the third largest city. Its textile factories specialize in woolen and linen weaving. Geneva, the fourth city, has long-established jewelry and precision-implement industries and chemical plants. Zurich and Basel are the chief transportation and commercial cities of the north, while Geneva controls the trade and transportation of the Rhone Valley. Geneva grew in international importance when it was the seat of the League of Nations. *(See also* Zurich; Bern; Geneva.)

SWISS YOUNGSTERS PREPARE FOR JOBS

These schoolboys are learning to make and decorate colorful wooden boxes for sale to tourists. Such training in handicrafts helps to prepare young people for the skilled work that is the basis of Switzerland's industries.

The Alp Mountains

The vast mass of the Swiss Alps is divided into two parts by the long east-west double valley cut by the Rhone and the Rhine. Limestone forms the jumble of lofty peaks and ridges north of the depression. The majestic southern mountains consist mainly of harder granites and gneiss. They slope abruptly on the southeast toward Lake Maggiore and Lake Lugano on the Italian border. Monte Rosa, the highest peak in the Swiss Alps rises to 15,217 feet. Fifty other summits tower above 12,000 feet. Among the most famous are the Matterhorn (14,780 feet), Jungfrau (13,667 feet), Finsteraarhorn, Aletschhorn, Weishorn, Mönch, and Eiger (*see* Alps).

The perpetual snow and ice on the high peaks feed a thousand glaciers that push slowly down the valleys (*see* Glacier). Water from the melting snow and ice drops from the cliffs in lacy waterfalls and courses down the valleys in swift torrents. From the Alps pour headwater streams for important rivers in addition to the Rhine and the Rhone. The Ticino River runs from the southern slopes of the St. Gotthard group of mountains into Lake Maggiore and on into the Po. The Inn River flows down the Engadine Valley of eastern Switzerland to meet the Danube. The Reuss, a leading tributary of the Aare, also rises in the St. Gotthard region.

Transportation routes have followed the long

SWISS CHILDREN AT PARTIES AND SPORTS

The little miss at the left is dressed for a party in the old-fashioned costume once worn by all Swiss mountain girls. An edelweiss, the national flower, adorns the lad's jacket. Skiing is popular in snowy Switzerland, and the girls and boys at the right are learning the sport early.

INDUSTRY IN FACTORIES AND HOMES

river valleys for centuries. The chief rail line from Italy into Switzerland climbs up the Ticino Valley to the great St. Gotthard Tunnel, then drops down to the plateau through the Reuss Valley. Another railway from the Po basin passes through the Simplon Tunnel to the upper Rhone Valley. (The lowest and most usable Alpine pass is the Brenner, between Italy and Austria, but it is not in Switzerland.) The east-west valleys of the Rhine and the Rhone permit travel through the heart of the Alps Cable railways ("funiculars") haul visitors up some peaks.

In the Alps, hard-working peasants make a living by farming and dairying; but the tourist business and hydroelectric power production from the tumbling streams are the chief sources of wealth. The only manufacturing consists of home industries and textile plants in the northeast The best-known towns of the region are resorts beside the lakes or in the northern Alpine valleys. These include Lausanne, Montreux, Interlaken, Luzern (Lucerne), and Glarus The best-known winter sports centers in the eastern Alps are Davos Platz and St Moritz. Locarno and Lugano are the largest resorts beside the southeastern lakes.

Industry and Commerce

The Swiss must buy from other countries their coal and oil, most of the raw materials for manufacturing, and half or more of such foods as wheat and sugar. They can manufacture rayon fiber, but other fibers must be imported. They bring in bauxite for their aluminum factories, raw chemicals for the chemical and pharmaceutical plants, and semifinished iron and steel for their machine works. Their only important home resources are timber, milk, hides, and skins for the cheese, milk chocolate, shoe and leather goods factories, and home-grown fruits and vegetables for a few canneries and wineries.

To pay for their imports, the Swiss export their fine manufactured goods Thousands of skilled workers and hydroelectric power from the mountain rivers are the most important factors in Switzerland's ability to produce the goods. Money spent by tourists, railway earnings, and interest on the foreign investments of Swiss citizens and companies also add to their income from foreign sources.

The People and Their Government

THE SWISS have created a prosperous, unified, and influential nation, in spite of the fact that the population is made up of three different peoples —Germans, French, and Italians. They speak the three languages of their ancestral homelands and a fourth dialect, Romansh. Some three-fifths of the people are Protestant and two-fifths are Roman Catholic.

More than 70 per cent of the Swiss use the German language. The wide "gate" to the Swiss plateau on the northeast has made travel from Germany easy. Teutonic peoples have been moving into

1 In the milk chocolate factory melted chocolate pours from the mixing pan into molds which a workman at the right has placed on a moving belt The candy hardens on the table at the left. 2 Skilled watchmakers assemble timepieces in a large Geneva factory 3 These pretty girls are working at home, stitching the Swiss embroidery that is famous throughout the world.

Switzerland since before the dawn of history. French, spoken by 20 per cent of the people, is the language of the Jura Mountains and the area around Lake Geneva and the lower Rhone Valley. The Italian-speaking 6 per cent live near the Italian border. The 1.7 per cent who speak Romansh, a dialect based on Latin, dwell in the eastern Alps.

The country has remained unified despite foreign minorities and influences because the people have given their first loyalty to Switzerland. Complete religious liberty has brought religious peace. Their command of the languages of their neighbors has served the Swiss well in foreign trade and the tourist business. The schools emphasize languages, and many people speak English.

Elementary education is compulsory, and illiteracy is almost unknown. The schools specialize in vocational training. They offer courses in industrial trades, hotel work, agriculture, stock raising, and railway work. Of the seven universities, the one at Basel, founded in 1460, is the oldest. Others are in Zurich, Bern, Geneva, Lausanne, Fribourg, and Neuchâtel.

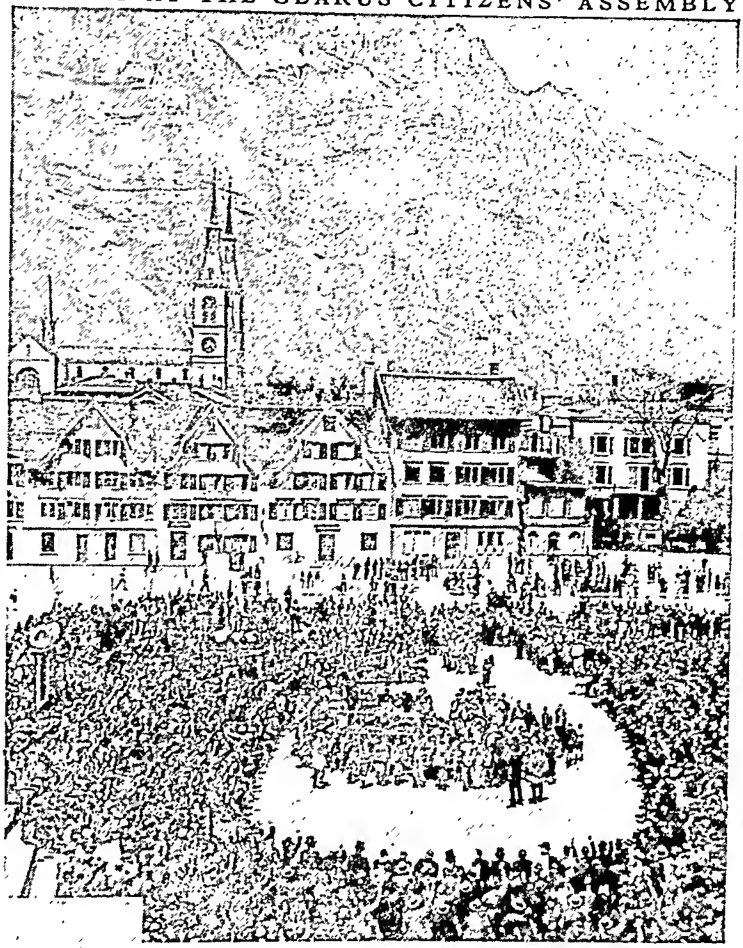
Republican Form of Government

Switzerland is the oldest republic of modern times. It has a federal form of government like that of the United States. Twenty-two cantons make up the Swiss confederation. The cantons are divided into districts and communes.

The cantons, like American states, retain control over local affairs and have their own legislative, judiciary, and administrative bodies. The federal government handles matters dealing with the country as a whole. It has a parliament, a federal council, a president, and a supreme court. The president is chosen from the seven members of the council. His term of office is only a year and he has much less executive power than the president of the United States. Citizens vote upon amendments to the constitution and certain other federal laws, and may petition for the passage of desired laws (referendum and initiative). In the cantons of Appenzell, Glarus, and Unterwalden, the citizens meet in open-air assemblies, called the *Landsgemeinden*, to pass laws and elect administrators.

The federal government owns most of the railways, bus lines, and air lines, as well as the postal, telegraph, and telephone services. The cantons operate schools and roads with federal aid.

VOTING AT THE GLARUS CITIZENS' ASSEMBLY



The historic *Landsgemeinde* is an example of direct democracy like the New England town meeting. Each year the citizens gather in the open to pass on laws and elect officials. Below, we see men voting by a "show of hands." The sword held by one man is a token of citizenship.

History of the Swiss

People lived in Switzerland long before the dawn of history. The Lake Dwellers made their homes around its lakes, particularly Lake Neuchâtel, during the New Stone Age. They lived by fishing, primitive farming, and stock raising. They built their houses on wooden platforms over the water to protect themselves from attacks by less civilized tribes of hunters. Relics dug from the lake bottom show that they could weave cloth and make implements of pottery, stone, copper, and, later, iron (*see* Man).

At the beginning of history, the Helvetians lived in the western part of Switzerland, and the Rhaetians controlled the eastern mountains. The Romans conquered the territory in the first century B.C., and it remained a part of the empire for four cen-

THE CASTLE OF CHILLON ON LAKE GENEVA

The stately castle, celebrated in Lord Byron's 'Prisoner of Chillon', stands on a rocky point at the eastern end of the lake near Montreux. It is one of the attractions that draw tourists to this lovely shore.

turies. Then warlike Teutonic tribes overran the western Roman Empire, and Switzerland was invaded by the Allemani and the Burgundians. Both of these peoples were conquered by the Franks, who introduced Christianity. The region was taken into the Holy Roman Empire in the 11th century. At that time it was made up of petty states and city states.

Three states, the forest cantons of Uri, Schwyz, and Unterwalden, joined in 1291 to defend their rugged land against Rudolph of Hapsburg, who dominated the empire. The "Perpetual League" they formed was the core around which the Swiss nation grew. Peasant soldiers defended their mountain passes with such ferocity that the armored knights of the Hapsburgs were thrown back. Famous battles included Morgarten in 1315, Sempach in 1386, and Nafels in 1388. Celebrated national heroes of the era were William Tell and Arnold von Winkelried (*see* Tell; Winkelried). The Swiss pikemen became so famous that for 200 years they were the most sought-after mercenary soldiers on the continent. More cantons joined the league and they maintained their liberty against the Austrians.

Meanwhile the Swiss played an important rôle in the Reformation. Zwingli preached in Zurich and led the Protestants in a religious civil war. Calvin taught in Geneva and welcomed John Knox and other refugees from persecution (*see* Zwingli, Calvin; Knox).

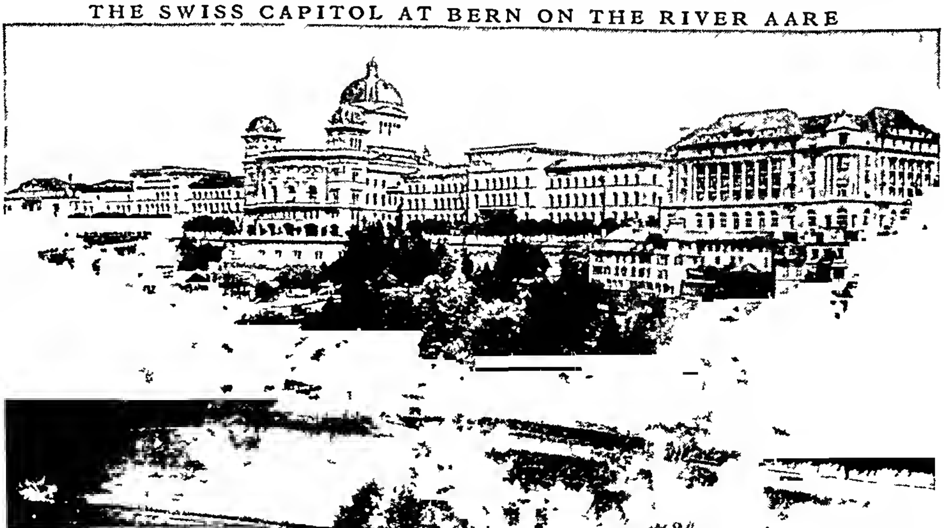
The French Revolution stirred reaction against the aristocrats who ruled various Swiss cantons. In 1798 the French occupied Switzerland and founded the Helvetic Republic. Its life was brief, for in 1803 Napoleon restored the confederation.

After Napoleon's downfall, the Congress of Vienna guaranteed perpetual neutrality to Switzerland as a buffer state. Switzerland has never since been invaded. The Great Powers have respected the ability of the Swiss to defend their land; and each neighbor has wished to be sure that no other power held Switzerland's strategic position.

Switzerland has gained the respect of the world as a peaceful and tolerant nation. It has welcomed refugees from war and persecution, and its people have led world humanitarian and peace movements. A Swiss, Henri Dunant, founded the Red Cross, whose international headquarters are in Geneva (*see* Red Cross Societies). The League of Nations had its offices in Geneva, and many international conferences have taken place in Switzerland.

The nation's long, peaceful relations with other lands have contributed to its prosperity. Since it lacks a seaport, it must receive raw materials and ship goods through neighboring territories. It

THE SWISS CAPITOL AT BERN ON THE RIVER AARE



Switzerland's large and handsome federal buildings rise on a bluff above the river. The two chambers of parliament, the *Standerat* and the *Nationalrat*, meet in the central section beneath the dome.

also needs friendly people as suppliers and customers for its industries.

World Wars I and II

During the two World Wars, Switzerland maintained its neutrality. When war broke out in 1939, the Swiss mobilized their citizen army. In the following year, after threats of German aggression, work was started on a project which turned the entire Alpine region into a vast fortress. A ring of self-sustaining forts was constructed by tunneling into the living rock of the mountains, and ammunition, gasoline, and oil were stored in dumps similarly cut in the rock. The lower valleys to the north and west were defended by less elaborate installations. The purpose of all the Swiss defenses was to delay and make as costly as possible the conquest of the little country by an aggressor nation.

Throughout the war, Swiss diplomats acted as intermediaries between hostile nations. They carried on exchanges of prisoners, located missing persons in war zones, and performed many other services. Finally the negotiations between Japan and the Allies, which ended the war, passed through their foreign office.

The Swiss opened their doors to persecuted civilian refugees and brought in thousands of children from bomb-scarred countries for a season of quiet and good food. Their industrialists continued to carry on a limited trade with people in both Allied and Axis countries, in accordance with special treaties.

The end of the war in 1945 found Switzerland an island of comparative peace and plenty in a shattered continent. Once more its hotels and winter sports resorts were crowded with travelers. The Swiss adopted a ten-year plan for constructing new hydroelectric projects and expanded their manufacturing and foreign trade. They did not join the United Nations, believing that membership obligations would be inconsistent with permanent neutrality. Swiss representatives served on the Neutral Nations Repatriation Commission for Korean war prisoners in 1953.

REFERENCE-OUTLINE FOR STUDY OF SWITZERLAND

THE LAND AND THE PEOPLE

I. Location and size S-477, list S-475: location in world, map W-205; in Europe, maps E-416, 425

II. Structure of the land S-477, list and map S-475
   - A. Mountains, valleys, and plateaus S-477-8, 479-80: Alps A-179-80 (Matterhorn, picture S-478); Jura Mountains J-365; Swiss Plateau, or Mittelland S-478-9
   - B. Rivers and lakes S-477, 479, list S-475: Rhine R-133; Rhone R-146

III. Climate S-477-8

IV. People S-480-1, pictures S-476, 479: farm life S-474-6; shelter S-474, pictures S-143, S-476, 478; winter sports W-158, 160, picture S-479

V. Resources and industries
   - A. Agriculture S-474-5, 479, picture S-476: cheese C-207, S-475; co-operative A-70
   - B. Water power S-476, picture S-477
   - C. Manufacturing S-476, 478, 479, 480, list S-475: toys, picture D-122*b*; watches and clocks, W-57, S-478; Zurich Z-366
   - D. Tourist industry S-476-7

VI. Trade and transportation S-476, 477, 479-80, 481: exports and imports, see in Fact-Index Trade, table; per capita foreign trade, table I-192

VII. Principal cities S-479, 480, list S-475: Bern B-132, picture S-482; Geneva G-35-6; Zurich Z-366

VIII. Education and the arts S-481, B-132, G-36, Z-366

IX. Government and religion S-480, 481, D-66, I-149

X. World humanitarian and peace movements S-482: Red Cross founded (1864) R-87; arbitration of 'Alabama' claims (1871) A-129; League of Nations established (1920) L-142; Lausanne Treaties (Fact-Index); United Nations U-242, L-142, G-35-6

HISTORY

I. Lake dwellers M-66, S-144, L-87, pictures M-68, S-144*a*

II. "Perpetual League" (1291) S-482: legend of William Tell T-55-6

III. Battles of Margarten (1315), Sempach (1386), and Näfels (1388) S-482: Arnold von Winkelried W-156

IV. Defeat of Charles of Burgundy (1746–47) C-195

V. Swiss leaders in the Reformation R-92: Calvin C-49; Zwingli Z-366

VI. Napoleonic Wars: Helvetic Republic (Fact-Index); Congress of Vienna guarantees neutrality S-482

VII. Bern becomes Swiss capital (1848) B-132

VIII. Neutrality in two World Wars S-483

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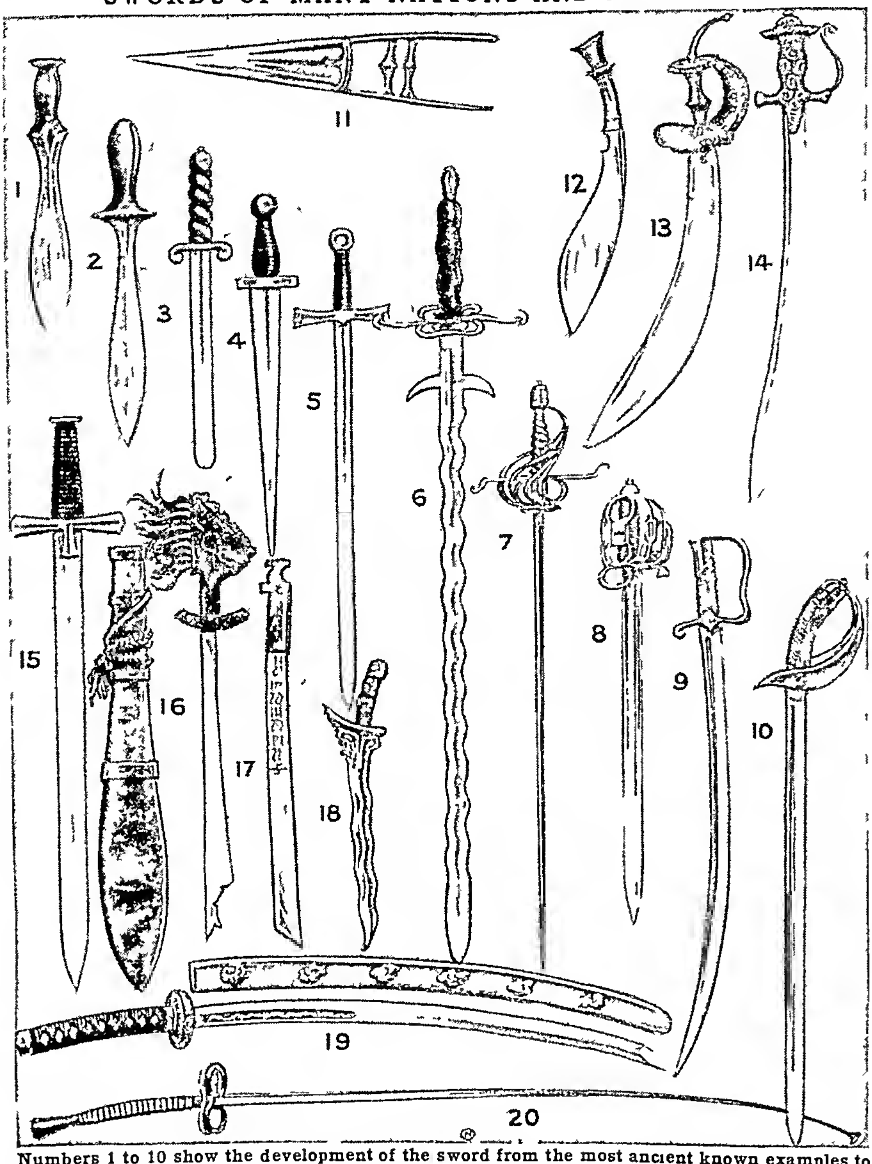
SWORD. That "most romantic of weapons," the sword, has been the symbol of war, the badge of honor and courage among fighting men, since the days when bronze and iron were first hammered into blades. The right to carry a sword has almost always been a mark of rank; and today, when most of its usefulness has departed, it remains part of the dress uniform of army and navy officers the world over.

SWORDS OF MANY NATIONS AND MANY AGES



Numbers 1 to 10 show the development of the sword from the most ancient known examples to the first World War; numbers 11 to 20 are modern weapons of various nations. 1. Sword of the Bronze Age. 2 Greek. 3. Roman. 4 Norman (about 1066) 5 Crusader's. 6. Two-handed, 15th century. 7. Rapier, 16th century. 8 Basket-hilted Ferrara, 17th century. 9 French cavalry saber, about 1800 10 English cavalry, 1914 11. Dagger from Mahratta. 12 Gurkha "kukri." 13 Indian "talwar." 14 Indo-Persian scimitar. 15 Sudanese sword and scabbard. 16. Sword from Timor (in the Malay Archipelago). 17 Central American "machete." 18 Malay "kris." 19. Japanese sword and scabbard. 20. Fencing foil.

In the days of chivalry knighthood was conferred by the flat of the sword laid on the young warrior's shoulder; in many lands kissing the ruler's sword was a token of homage; oaths taken by a soldier on his sword were rigidly binding; when a general surrendered his sword, he admitted complete defeat; and to have his sword broken by his superior officer was the worst degradation that could come to the disloyal or cowardly soldier. These and many other sword ceremonies reappear constantly in history, while all mythologies and folklore contain tales of magic swords, like King Arthur's "Excalibur."

In modern warfare, the work of the sword, and of its smaller brother, the dagger, and of its cousin, the spear or lance, is mostly done by the bayonet fastened to the rifle muzzle, or carried in a scabbard at the belt. But for many centuries before the invention of firearms, the sword in one or another of its many forms was the principal weapon of the fighting man.

The sword's ancestor was probably the stone dagger of the cave man. Among the earliest historical blades are the leaf-shaped arm of the Greeks and the long thin Assyrian sword. As nations progressed in the military arts, they usually shifted from the chopping swords to the sharp-pointed thrusting weapons. Thus the short sword of the Roman legionary defeated the heavy blunt-ended sword of the northern barbarians, and it was literally "at the point of the sword" that the Mohammedans, who carried curving scimitars and yataghans which could only be used for slashing, were kept out of Europe.

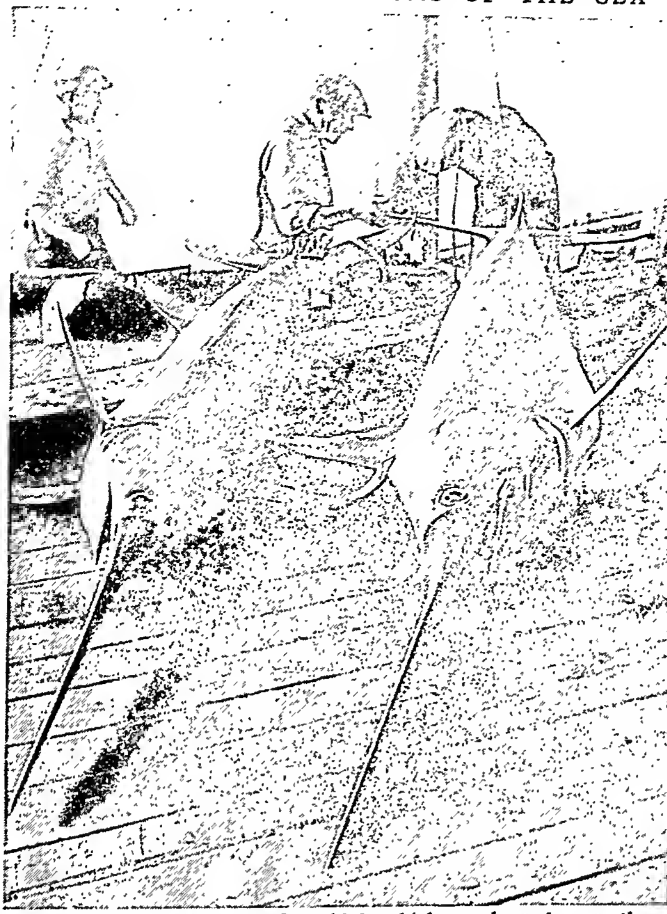
The heavy two-handed sword of the Middle Ages was abandoned as soon as the invention of firearms destroyed the usefulness of shields and armor. In its place grew up the saber, the rapier, and the smallsword, and with these lighter blades swordsmanship became a fine art. During the 17th and 18th centuries in Europe, it became the custom for all men, even civilians, to carry swords, and quarrels were usually settled on the spot with cold steel. In the reign of Louis XIII in France

dueling became such a rage that fencing masters were everywhere in great demand and highly honored. Earlier duels were fought with sword in one hand and dagger in the other for parrying. Later a cloak took the place of the dagger, and finally with the adoption of the slender, needle-pointed rapier even this protection was abandoned.

The saber, either straight or curved, was always the special weapon of the cavalryman, and it survives today in some armies. The short cutlass was the arm of the sailor.

Various races and peoples have had special swords and daggers associated with their names throughout history. Thus we hear of the curved tulwar of the Persians, the sickle-shaped kukri of the Indian Gurkhas, the Malay kris with its wriggling blade, the delicate katana of the Japanese, the heavy-pointed machete of tropical America, the deadly bolo of the Filipinos, the bowie knife of early frontier days, and scores of other members of the sword family. Sword making used to be one of the most honorable trades. The cities of Damascus, and of Toledo in Spain, formerly owed much of their reputation to the skill of their swordsmiths.

VANQUISHED GLADIATORS OF THE SEA



The sharp stout beak of the Swordfish, which may be as long as three feet, can pierce the planking of any ordinary small craft. This makes the sport of catching Swordfish, whether by rod and reel or by harpoon, thrilling and hazardous.

Swordfish and Sailfish. A champion duelist and bullying swashbuckler of the open seas is the huge swift swordfish, whose rapier-like snout is always ready as a weapon of attack or defense. Like an insolent soldier of fortune this bold fish roams the seas far and wide. He infests the Mediterranean, and travels widely in both the Pacific and Atlantic.

The swordfish is shaped like a mackerel. He grows from 4 to 15 feet long, weighs from 150 to 800 pounds, and fears nothing that swims or floats. His "sword," sometimes three feet long, is formed by the prolonged and toughened bone of the upper jaw, which is somewhat flattened and has an exceedingly sharp point.

Swordfish swoop upon a school of menhaden, herring, or mackerel, stabbing and cutting up in a few minutes an incredible number of these fish, which they then proceed to eat. But they gladly turn from their prey to attack a whale or a giant squid, toward which they seem to feel an unreasoning ferocity. In these combats they are usually victorious.

Swordfish frequently assail boats and ships, probably mistaking them for whales. They easily pierce the light canoes of the Pacific island natives, and even the heavier ships of the professional swordfish-hunters, often wounding persons in the boats. Attacks by these monsters even on larger ocean-going vessels have been so common in the past as to be recognized in law as among the "perils of the sea." An English jurist once described in court the power of their attack as "equal to the accumulated force of 15 double-handed hammers!" They shoot themselves through the water with such speed that they have been known to drive their sharp weapons clear through the copper sheathing, oak planks, and timbers of a ship to a depth of ten inches. In a museum in London is preserved a section of ship-planking a foot square which incloses the broken ends of three "swords" of these fish, driven in during a joint attack on a vessel. Swordfish are much sought as food. Several thousand are taken every year off the New England and California coasts.

Another beaked monster of the sea is the sailfish, a near relative of the swordfish, although it is placed in the separate family, *Istiophoridae*. This fish is named from his sail—a huge, spotted dorsal fin, which can be raised or lowered along the back at will. What a sight it is to see this great fellow, from six to eight feet long, leaping far into the air, again and again, as if he were made of steel springs! These inhabitants of semi-tropical seas are very rapid swimmers. Often they may be seen among smaller fish along reefs, furiously lashing their long, bony beak about, disabling and then feasting on their unfortunate victims. The swordfish and sailfish give hours of thrilling sport and battle to the skilled anglers who hunt these big monsters with the rod and reel. The scientific name of the swordfish is *Xiphias gladius;* of the common Atlantic sailfish, *Istiophorus americanus.*

SYCAMORE. One of the largest and most luxuriant of forest trees is the sycamore, or buttonwood, names by which the species of plane tree native to the United States is commonly called. It is found along banks of streams and in rich bottomlands throughout the country but is most abundant and attains its largest size in the valleys of the lower Ohio and Mississippi rivers.

The sycamore is a rugged handsome tree, from 70 to 120 feet high, with occasional giants 150 feet high. It is often divided near the ground into several secondary trunks, with spreading limbs at the top which form an irregular open head. The old bark flakes off in irregular brownish sheets, exposing the smooth greenish white new bark in mottled patches beneath. In the winter especially the ghostly white of the trunk and limbs gives the tree a weird and striking aspect. The flaking off of the bark is explained by the fact that the bark tissue is rigid and incapable of expanding with the tree's growth, as does the bark of other trees.

THE SYCAMORE, WITH LEAVES AND "BUTTONS"

The plane trees, of which the sycamore is the American species, get their name from the Latin word which means flat or broad. The sycamore thrives best in the rich alluvial soil of the river valleys in the Central Western states.

The broad leaves of the sycamore are bright yellow-green above and paler below. The fruit is a round buttonlike ball of fluff which swings in the wind on its long stem through most of the winter. The beautifully grained reddish-brown wood is used for the interior trimmings of houses, for furniture and desk trimmings, and for cigar boxes.

The oriental plane tree is a native of Greece and western Asia. It was a favorite shade tree of the ancient Greeks and Romans and was introduced by the latter into southwestern Europe.

The scientific name of the sycamore is *Platanus occidentalis*. The bark is reddish brown on the lower part of the tree and smooth and light gray above. The wood is heavy, weak, and difficult to split. The leaves are alternate, 4 to 9 inches long, and 3- to 5-lobed. The petioles are long and abruptly enlarged at the base; they enclose the buds. The fruit is a brown ball an inch in diameter.

SYDNEY, AUSTRALIA. Australia's greatest city is Sydney, on the east coast, the capital of New South Wales. The city lies on both sides of a magnificent harbor formed by an old river valley. Long ragged peninsulas jut out from the shore. Because the north shore is steep, the city spread first over the flatter land to the south, and this area is still the business and industrial section. The hilly north shore is now lined with attractive residential suburbs.

One of the world's greatest bridges, Sydney Harbor Bridge, links the north and south shores. The length of the main span is 1,650 feet, and the bridge is wide enough (160 feet) for six lanes of auto traffic, two rail, and two trolley tracks. On Cockatoo Island in the harbor is a naval shipbuilding and repair base with a huge dry dock.

Sydney has many imposing buildings. Especially fine are those of the University of Sydney. Along the north shore, houses with red-tiled roofs dot the wooded hillsides down to the water's edge. The climate is warm throughout the year. On weekends, people sail their pleasure craft in the island-studded harbor or flock to Pacific Ocean beaches for surf riding, bathing, or swimming. A great fleet of ferryboats carries people to the beaches and to various points in the harbor.

Wool is the principal product shipped from Sydney, and the world price of wool is determined largely in its Royal Exchange, where more than a million bales are auctioned each year. Sydney's factories, run by coal from mines nearby, produce a good share of the country's manufactures.

Captain James Cook sighted Sydney's harbor in 1770 and named it Port Jackson, a name it still bears today. In January 1788 Capt. Arthur Phillip arrived in Australia with 11 ships carrying convicts from Britain. He landed first at Botany Bay and explored the coast northward. On January 26 he moved the colony to the south shore of Port Jackson. He named the settlement Sydney Cove, in honor of Lord Sydney, the British home secretary. Even before the transportation of convicts ended, in 1851, free settlers began to pour into Sydney. The city was the seat of the government of the Commonwealth of Australia from 1901 to 1927, when parliament was moved to Canberra. Population (1947 census), 1,484,434.

SYRACUSE, N.Y. Once known as "The Landing," a small trading post at the marshy southern tip of Lake Onondaga, Syracuse has become the fourth largest city in the state. A central geographic position in upstate New York; excellent water, rail, and highway transportation; and ready access to raw materials and to a surrounding area of rich dairy and other farms—all contribute to the city's present importance.

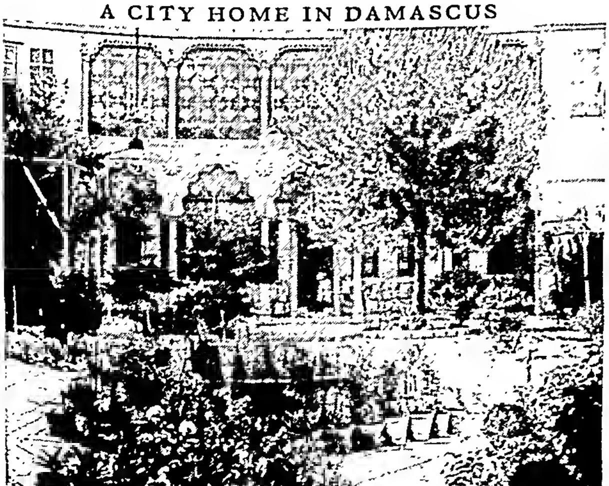
One of the city's earliest manufactures was salt. The salt springs on its site were known to the Indians and early settlers. Later, because of salt production, Syracuse was called the "salt cellar of the nation." The city no longer makes table salt but uses its salt and native limestone to manufacture chemicals.

Syracuse now produces many kinds of goods for modern living. The city is one of the largest manufacturers of air-conditioning equipment and in its laboratories penicillin and many other drugs are produced. Other large industries include the assembly of automobiles and the making of washing machines, traffic signals, cans, and office equipment. Just outside the city is a new "Electronics Park" where electrical equipment research and manufacturing are carried on.

The city has a modern business district, fine residential areas, many scenic parks, and an excellent Museum of Fine Arts. It is the seat of Syracuse University, with its affiliated New York School of Forestry; and of Le Moyne College, named for the Jesuit priest who discovered the salt springs in the 1600's. The New York State Fair is held at Syracuse yearly.

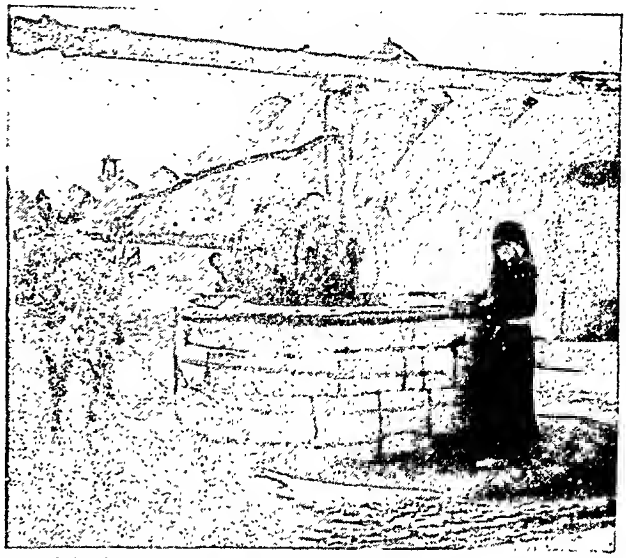
In the 1700's the site of Syracuse was the capital of the Iroquois Confederacy. Representatives of the Six Nations met here to talk over tribal affairs. Syracuse was chartered as a city in 1847. It was named for the Greek city in Sicily. The Erie Canal passed through Syracuse after completion in 1825. Today Erie Boulevard runs over the old canal bed. The city is connected with the New York State Barge Canal by way of Lake Onondaga near by. Syracuse has the mayor-council form of government. Population (1950 census), 220,583.

A CITY HOME IN DAMASCUS



The wealthy Syrian uses his courtyard for a living room in the hot summer months. High walls surround it, casting cool shadows. At night this court is lighted by electricity.

A VILLAGE IN NORTHERN SYRIA



The blindfolded donkey turns the stone wheel which grinds grain. The "beehive" huts have thick walls of sun-baked mud which help keep out summer heat and winter wind.

SYRIA AND LEBANON. From earliest history, the Syrian region has been a crossroads for trade and war. People from everywhere met in this little region at the northeast "corner" of the Mediterranean Sea. Ships came from Egypt, Greece, and Rome. Caravans came from the east, bringing goods from Mesopotamia, Persia, India, and even China. Inventions, literature, and new religions were brought here, then spread through Asia, North Africa, and Europe.

Through the centuries, conquering armies swept over the region from every side. The ancient Greeks named the land Syria for one of the conquerors, the Assyrians. In the Middle Ages, Italian shipmasters called the region the Levant. To them it was the *levante* ("place of rising") of the sun. Today most of it is governed by the Republic of Syria. The Republic of Lebanon governs some of the coast. The area of Syria is estimated from 66,000 to 72,000 square miles; population (1949 est.), 3,135,000. The area of Lebanon is estimated from 3,475 to about 4,000 square miles; population (1946 census), 1,165,200.

Natural Features of the Levant

The east portion of Syria is in the northernmost part of the Arabian Desert. On the north and west edges of the desert lies a belt of land called the Fertile Crescent (for map, *see* Egypt, Ancient). East Syria contains a part of this important strip.

Syria's coastal plain is hemmed in by the Lebanon Mountains which reach heights of 10,000 feet. A few miles east of this range stands the equally lofty Anti-Lebanon chain. Between these two ranges lies a long, narrow valley. Through it the Nahr el Asi (the ancient Orontes River) flows northward into Turkey, then west to the Mediterranean. The Litani (ancient Leontes) flows south, then turns abruptly westward to the sea. In the extreme south, melted snow drains from Mount Hermon into the Jordan River of Palestine. Across northeastern Syria the Euphrates River crosses the Fertile Crescent to Iraq.

The climate is sub-tropical. Rain is abundant only along the coast and falls chiefly in winter. But the inland valley and the eastern slope of the Anti-Lebanon range are studded with irrigated gardens. Melting snows from the high mountains feed rivers through the long, hot, rainless summers.

The capital of Syria is Damascus, one of the oldest cities in the world (*see* Damascus). It lies in the east at the desert's edge. The Barada River waters the beautiful countryside around the city. At the north end of the inland valley stands Aleppo (Alep), a commercial center of great antiquity. Farther south are Hama and Homs, surrounded by fruitful oases. Lebanon has the better seaports at Beirut, the capital, and at Tripoli. Tripoli receives one fork of the oil pipeline from Iraq. Sidon is the terminus of the line from Saudi Arabia. Syria's only seaport is Latakia.

The people of the Levant states are mainly Semites and practically all speak Arabic. But they adhere to several religions, and religious feuds prevent unity. In Lebanon the majority belong to a Christian sect called Maronites. They accept the jurisdiction of the pope but have many special observances. They are hated by the Druses, fanatical Moslems who live in the uplands of southeastern Syria (called the Jebel Druse, meaning "Druse Mountain"). The warlike Druses in turn often fight with the Moslems of Syria. In general the Maronites surpass the Moslems in education and in their standard of living. Beirut is the home of a noted American University.

BOYS LEARN THE ART OF INLAYING

These young apprentices are cutting out bits of mother-of-pearl and setting them into carved wood. The cabinet maker keeps a watchful eye on them.

The Levant states have few minerals and little manufacturing. Most of the people live by farming and grazing livestock. The main crops are wheat and barley. Olive trees grow almost everywhere; raisin grapes grow around Damascus; and apricots, bananas, figs, and citrus fruits thrive along the coast. Licorice grows wild in the hills. Tobacco grown in Syria but cured in Lebanon is called Latakia. It is prized by American manufacturers. At the edge of the desert nomad Arabs pasture sheep and goats, camels and donkeys. Pine is fairly abundant, but the famous cedars of Lebanon survive in only a few groves.

A modern highway, following the ancient caravan trail along the Euphrates, links Aleppo with Baghdad in Iraq. During the second World War the British built a railway from Tripoli to Haifa in Palestine, the last link in the line between Turkey and Egypt. Several air lines pass through Syria.

The Phoenicians developed cities on the coast of Syria before 2000 B.C. By 1000 B.C. they were carrying on a thriving seaborne commerce from Tyre and Sidon (*see* Phoenicians). Later the land was conquered successively by the Babylonians, the Persians, and Alexander the Great. One of Alexander's generals, Seleucus, became king of Syria. The Seleucid dynasty lasted until Syria became a province of Rome in 64 B.C.

Under Roman rule, Syria flourished and Christianity spread. When the Roman empire was divided, Syria was part of the Byzantine Empire. In the 7th century the Saracens (Arabs) appeared. Mohammedanism displaced Christianity and the Arabic language gradually supplanted Aramaic, the ancient Syrian tongue. In the 11th century Syria fell to the Seljuk Turks and remained under Turkish rule until the first World War (*see* Turkey).

In 1922 the League of Nations granted France mandates over Syria and Lebanon. Lebanon at first welcomed French rule; but year after year the Moslems in Syria revolted. In 1925 the French shelled Damascus to quell a great Druse rebellion. In 1936 France promised to end the mandate in three years; but when the second World War broke out independence was deferred. In 1939 France ceded to Turkey the Sanjak Alexandretta, a coastal area bordering on Turkey. After France fell in 1941, British and Free French troops occupied the Levant. Riots broke out in 1945 when France landed more troops. Syria and Lebanon protested to the United Nations; France and Britain withdrew. Greedy landowners and other privileged classes, however, balked Syria's progress. In 1951–52 army officers seized the inept government and began land and social reforms. Progress was slow, and in 1954 the army rebels ousted their own leader and reinstated a civilian government.

SYRINGA (*sĭ-rĭng'ga*). In popular usage this name is applied to a hardy flowering shrub often seen in gardens, also known as the false syringa or mock-orange (*Philadelphus coronarius*). It is a native of western Asia and perhaps of some parts of southern Europe. It grows as a spreading bush from two to ten feet high with smooth ovate leaves and cream-colored fragrant flowers, somewhat resembling orange blossoms and growing in clusters. It is the official state flower of Idaho. The name syringa is also given to a genus of Old World shrubs of the olive family to which the lilac belongs.

THE EASY REFERENCE FACT-INDEX

GUIDE TO ALL VOLUMES FOR SUBJECTS BEGINNING WITH

S

TO SAVE TIME

USE THIS INDEX ☞

EDITOR'S NOTE ON NEXT PAGE TELLS WHY

SPECIAL LISTS AND TABLES

Numerous other lists and tables in the fields of geography, history, literature, science, mathematics, and other departments of knowledge will be found with their appropriate articles in the main text

EDITOR'S NOTE

EVERY user of Compton's Pictured Encyclopedia should form the habit of *first* turning to the Fact-Index section at the end of each volume when in search of specific information. This index is a miniature work of reference in itself and will often give you directly the facts, dates, or definitions you seek. Even when you want full treatment of a subject, you will usually save time by finding in the index the exact page numbers for the desired material.

All page numbers are preceded by a letter of the alphabet, as A-23. The letter indicates the volume. If two or three page numbers are given for the topic you are seeking, the first indicates the more general and important treatment; the second and third point to additional information on other pages. Where necessary, subheadings follow the entry and tell you by guide words or phrases where the various aspects of the subject are treated.

The arrangement of subheadings is alphabetical, except in major historical entries. In these the chronological order is followed.

The pictures illustrating a specific subject are indicated by the word *picture* or *color picture* followed by a volume indicator and a page number. A picture reference is frequently intended to call attention to details in the text under the illustration as well as to the illustration itself. This picture-text, therefore, should always be carefully read. The pictures are usually on the same page as the text to which you are also referred; sometimes they are found in a different but related article which will add interest and information.

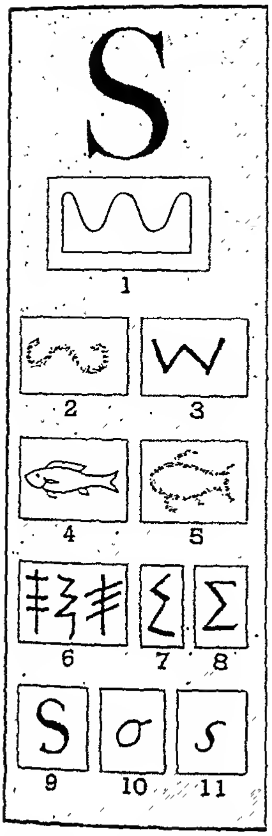
The pronunciations given are those preferred by the best and most recent authorities; alternative pronunciations are indicated where usage is divided.

In recent years hundreds of foreign geographical names have been changed, either officially or by custom. Both old and new names are given at the appropriate places in the alphabet.

Populations are those of the latest census or an official estimate when available if no census has been taken since World War II. Distances between points are map or air distances, not distances by railroad.

THE EASY REFERENCE FACT-INDEX

Reg. U. S. Pat. Off.



OUR LETTER S has gone through many changes, because the peoples who developed alphabetic writing invented signs for several combinations of the 's' sound with other sounds. This variety of signs caused much confusion before our letter 's' became firmly established.

The confusion started soon after 2000 B.C., when a Semitic people called the Seirites adopted several pictures from Egyptian writing for use as alphabetic signs. The first picture (1) meant 'dunes' or 'desert' to the Egyptians; but the Seirites used it as a sign for the sound of 's' or 'sh', because to them the sign looked like a *shin* or camel's tooth. Their crude sign (2) passed into the later Canaanite-Phoenician alphabet with the curves sharpened into angles (3).

The Seirites also developed another sign for 's' from an Egyptian fish (4) because of their word *samekh* or *semket* for 'fish'. The Canaanite-Phoenician script changed the Seirite picture of a fish (5) into something more like fishbones (6), or a trellis for grapevines. All Semitic languages gave these two signs names somewhat like the Hebrew term *shin* for the tooth sign, and *samekh* for fishbones.

When the Greeks learned writing from the Phoenicians, they used the *shin* sign for 's', but turned it sidewise (7). Later they made it more gracefully (8). But though they took their 's' sign from *shin*, they named the sign *sigma*, from *samekh*. The actual sign for *samekh* meanwhile became the forerunner of our 'x', as told in the Fact-Index article on X.

When the Romans learned to write in Greek fashion, they took the Greek *sigma* but rounded it and left off the bottom stroke. This gave the Latin S (9). From Latin the sign for capital S came without change into English.

The small handwritten 's' has taken many forms, but the forms used today come from the Greek shapes within a word (10), and at the end (11).

NOTE.—For the story of how alphabetic writing began and developed, *see* the articles Alphabet; Writing.

Saadi. *See in Index* Sadi

Saale (*zä'lŭ*) **River**, in central Germany; flows n. 250 mi. to Elbe River: *map* G-88

Saalfeld (*zäl'fĕlt*), old German town on Saale River, 60 mi. s.w. of Leipzig; ruined Sorbenburg Castle said to have been built by Charlemagne; French defeated Prussians 1806.

Saanen goat, a breed of Saanen Valley, Switzerland; first imported into U.S. in 1904: G-128

Saar (*zär*) **Basin**, or **Saarland**, valley of Saar River; in French zone of occupation, w. Germany, along Lorraine boundary; coal-mining center; held alternately by France and Germany since 17th century; after World War I, administered by League of Nations until 1935 when, by plebiscite, Saarland (area at that time 737 sq. mi., pop. 865,000) reunited with Germany; occupied by U.S. forces May 1945; placed under French Military Government July 1945; frontier revised June 1947, making area 900 sq. mi.; pop. 851,615; a constitution went into effect Dec. 15, 1947, providing for representative government and for an economic union with France; 1952 parliamentary elections confirmed this status; independent status under Western European Union achieved with signing of Paris pacts May 5, 1955: *map* E-425
flag F-136*b–c*, color *picture* F-133

Saarbrücken (*zär'brük-ĕn*), city on Saar River, 40 mi. n.e. of Metz; pop. 89,700; in Saar Basin; coal-mining center; scene of first action in Franco-Prussian War; heavily damaged in World War II: *map* E-425

Saaremaa (*sä'rĕ-mä*), or **Saare Island**, formerly Ösel (*ü'sĕl*), largest island of Estonia, in Baltic Sea, at mouth of Gulf of Riga; 1046 sq. mi.; chief port Arensburg (Estonian Kuressaare), pop. 4478; held by Sweden 1227–1561, when taken by Denmark; retaken by Sweden 1645; fell to Russia 1721, to Germany 1917; given to Estonia 1918 after World War I: *maps* N-301, R-266

Saarinen (*sä'ri-nĕn*), **Eero** (born 1910), American architect, born Finland; came to U.S. 1923, became citizen 1940; associated with father, Eliel Saarinen, in designing many projects including opera shell at Berkshire Music Center, Lenox, Mass., and General Motors Technical Center near Detroit, Mich.; also designer of modern furniture.

Saarinen, Eliel (1873–1950), architect, born Finland; father of Eero Saarinen; expert in city planning; director Cranbrook Academy of Art, Bloomfield Hills, Mich., after 1925, also head of department of architecture there.

Saba (*sä'ba*), island in Netherlands West Indies, in n.w. Leeward Islands; 5 sq. mi.; pop. 1125; the island is a volcanic cone, and the principal settlement, Bottom, lies in the extinct crater; fishing, small-boat building, lacemaking: *map* W-96*a*

Sabaki River, in Kenya Colony, Africa; flows into Indian Ocean; 400 mi. long: *map* E-199

Sabatier (*sá-bá-tyā'*), **Paul** (1854–1941), French chemist, born Carcassonne; for his hydrogenation of organic compounds, he shared 1912 Nobel prize in chemistry with Victor Grignard; this hydrogenation commercially important in hardening fats.

Sabatini (*sä-bä-tē'nē*), **Rafael** (1875–1950), British novelist and dramatist, born Jesi, Italy; proficient in many languages, preferred to write in English; colorful historical romances ('Scaramouche'; 'Captain Blood'; 'The Sea Hawk').

Sabaudia, Italy, town in province of Littoria; pop. 5,000: *picture* I-268

Sabbath S-1
American Colonies A-210

Sabbath, witch W-179

Sabbatical year, in ancient Hebrew law, every seventh year during which fields were to lie fallow. Term now applied to a year's vacation awarded to teachers after six years of service.

Sa'ber S-485, F-52, *pictures* F-51, S-484

Saber-toothed tiger S-1–2, P-406*c*, *pictures* S-1, P-406*a*

Sabians, religious sect in Iraq I-225

Sabin, Florence Rena (1871–53), anatomist, born Central City, Colo.; professor of histology, Johns Hopkins University 1917–25; member Rockefeller Institute for Medical Research 1925–38; member emeritus after 1938; first woman elected to National Academy of Science.

Sabine (*sá-bēn'*) **Cross-Roads**, place 3 mi. s.e. of Mansfield, La., where Confederates defeated Federal forces and stopped Red River expedition, April 8, 1864.

Sabine Lake, expansion of Sabine River in Texas 5 mi. above Gulf of Mexico; forms part of boundary between Texas and Louisiana; 18 mi. long, 9 mi. wide: B-89, *maps* L-333, T-91

Sabine River, a stream flowing 400

Minn.; Roman Catholic; for men; chartered and opened 1857; arts and sciences, theology.

St.-John's-wort, genus of plants, *Hypericum*; includes klamathweed or common St. Johnswort (*Hypericum perforatum*), native to Europe but now found in North America: I-153

St. John the Divine, Cathedral of, in New York City, Amsterdam Ave. and 110th St.; Episcopal; Gothic architecture; area 121,000 sq. ft., length 601 ft.; cornerstone laid 1892; crypt opened for worship 1899, nave 1941; two thirds completed 1948: N-222
architecture A-320, *picture* A-323
sculptures, *picture* S-78

St. Joseph, Mich., summer resort and manufacturing city on St. Joseph River; adjoins Benton Harbor; pop. 10,223: *map* M-227

St. Joseph, Mo., city 50 mi n.w. of Kansas City, on Missouri River; pop. 78,588; important livestock center; meat packing, paper products, cereal manufacturing, clothing, candy; St. Joseph Junior College: *maps* M-318, U-253
Pony Express F-43, P-388

St. Joseph College, at Emmitsburg, Md.; Roman Catholic; for women; founded 1809; arts and sciences.

St. Joseph College, at West Hartford, Conn.; Roman Catholic; for women; incorporated 1925, opened 1932; arts and sciences, education, nursing.

St. Joseph River, in n. Indiana and Michigan; flows 200 mi. to Lake Michigan at St. Joseph: *maps* M-219, 227, I-78

Saint Joseph's College, at Collegeville, Ind.; Roman Catholic; for men; founded 1889; opened 1891; arts and sciences.

St. Joseph's College, at Philadelphia, Pa.; Roman Catholic; for men; founded 1851; arts and sciences, business administration, co-operative 5-year work-and-study program in electronics.

St. Joseph's College for Women, at Brooklyn, N. Y.; Roman Catholic; founded 1916; arts and sciences.

St. Joseph's Oratory, in Montreal, Canada M-381

Saint-Just (*săṅ-zhüst*), **Louis Antoine Léon de** (1767–94), French revolutionist, associate of Robespierre and Danton; one of organizers of Reign of Terror; member of Committee of Public Safety; arrested and guillotined with Robespierre
Danton denounced by D-15

St. Kitts, British West Indies. *See in Index* St. Christopher

St. Laurent (*săṅ lō-räṅ'*), **Louis Stephen** (born 1882), Canadian statesman S-18, C-103, *picture* S-18

St. (*sānt*) **Lawrence, Gulf of**, inlet of n. Atlantic at mouth of St. Lawrence River: S-19, *maps* C-69, 73. *See also in Index* Ocean, *table*

St. Lawrence Island, Alaskan island in Bering Sea, s.w. of Nome; 88 mi. long and 20 mi. wide; inhabited chiefly by Eskimos; reindeer and foxes: *maps* N-250, A-135

St. Lawrence Islands National Scenic and Recreational Park, in Ontario, Canada; has 13 of the Thousand Islands and a mainland area in Ontario; resort facilities: N-38*f*, *map* N-38*f*

St. Lawrence River, one of chief rivers of North America, outlet of the Great Lakes; 740 mi. long from Lake Ontario to Gulf of St. Lawrence: S-19–21, G-183, *maps* S-20, C-69, 72–3, N-245, *pictures* C-70, S-19
bridges B-306, 308, *picture* B-309. *See also in Index* Bridge, *table*
canals C-109, S-19, *map* S-20. *See also in Index* Canal, *table*
Cartier's explorations C-129–30
Champlain S-19
commerce S-19, *map* S-20: Montreal M-381; Quebec Q-11
named by Cartier S-19
Quebec water front, *picture* S-19
rapids S-19, *maps* S-20
river system, *map* U-257
United States-Canada use C-100
valley C-75, Q-5, *map* C-67
why it has no floods R-156

St. Lawrence Seaway S-20–1, R-157, N-211, E-287*e*
Canada S-20–1, O-387, C-103

St. Lawrence University, at Canton, N. Y.; chartered 1856; opened 1857; letters and sciences, theology (Universalist).

St. Lawrence waterway S-20–1, R-157
canal, *picture* C-108*b*

Saint Leger (*sānt lĕǵ'ẽr* or *sĕl'in-ǵẽr*), **Barry** (1737–89), British soldier; fought under Wolfe at Quebec; during Revolutionary War commanded British at Fort Stanwix, which he failed to take: R-128*a*

St. Lô (*săṅ lō'*), France, historic town 50 mi. s.e. of Cherbourg; pop. 5190; textiles, farm machinery: *map* E-425

Saint Louis (*săṅ lwē'*), capital of Senegal and Mauritania, French West Africa; in Senegal on island 11½ mi. above mouth of Senegal River; oldest French colonial establishment in Africa (1626); unhealthful climate; pop. 63,000, about 1000 Europeans: *map* A-46

Saint Louis (*sānt lọ'is*), Mo., largest city of state and chief market for central Mississippi Valley; near junction of Mississippi and Missouri rivers; pop. 856,796: S-21–2, *maps* U-253, *inset* M-319, *pictures* S-21, M-323
art museum. *See in Index* Museums, *table*
bridges S-21, *picture* S-21
Chain-of-Rocks Bridge. *See in Index* Bridge, *table*
early river trade M-310
Federal Reserve Bank (8th) and district, *map* F-49
fountain by Carl Milles S-81–2, S-22, *picture* S-81
fur trade S-22, S-89: beginnings of F-324
German element I-46
Louisiana Purchase Exposition S-22
Missouri Botanical Garden B-262, S-22
natural gas, pipelines supply G-33
presidential conventions. *See in Index* Convention, *table*
Soldiers Memorial, *picture* M-323
zoo Z-360

Saint Louis Park, Minn., village 5 mi. s.w. of Minneapolis, chiefly residential; pop. 22,644; hydraulic manufacturing, machine shops: *map, inset* M-287

Saint Louis University, at St. Louis, Mo.; Roman Catholic; founded 1818 (university since 1832); arts and sciences, aeronautical technology, commerce and finance, dentistry, divinity, institute of technology, law, medicine, nursing, philosophy and letters; graduate school
Vatican manuscripts microfilmed R-194

St. Lucia (*lū'shạ* or *lọ-sē'ạ*), island, a British colony, in Windward Islands group, West Indies; 233 sq. mi.; pop. 70,113; cap. Castries; sugar, cacao, coconuts, limes, bay oil: *maps* W-96*a*, N-251

St. Lusson (*săṅ lü-sôṅ'*), **Simon François Daumont, sieur de**, 17th-century French soldier and explorer; headed expedition to upper Great Lakes (1670–71); before Indians of 14 tribes at Sault Ste. Marie, claimed for Louis XIV territory "discovered and to be discovered."

Saint-Malo (*săṅ-mȧ-lō'*), France, fortified port, resort on English Channel; pop. 10,873: *maps* F-259, E-425
Cartier at C-129, C-130

St. (*sānt*) **Marks**, Fla., village on St Marks River near the Gulf; pop 391: *map* F-158
Jackson captures (1817) J-286

St. Mark's (Italian **San Marco**), cathedral in Venice I-280, V-445, *pictures* I-281, V-447
bell tower B-118
Pala d'Oro, Byzantine reredos B-374

St. Martin, an island in n.w. Leeward Islands, West Indies; the n portion (20 sq. mi.; pop. 6786) belongs to French overseas department, Guadeloupe, and the s. portion (17 sq mi.; pop. 1568) to Netherlands West Indies: *map* W-96*a*

St. Martin-in-the-Fields, Georgian church in London, England, built 1721–26 by James Gibbs, *picture* L-299

St. Martin's College, at Olympia, Wash.; Roman Catholic; for men; founded 1895; arts and sciences, civil engineering, economics and business.

St. Martin's summer F-59

Saint Mary College, at Xavier, Kan.; Roman Catholic; for women; founded 1930; arts and sciences

St. Mary Magdalen (*mad'lin*) **College**, Oxford, England O-434
tower, *picture* O-432

St. Mary of the Springs, College of, at Columbus, Ohio; Roman Catholic; for women; founded 1925; arts and sciences.

St. Mary-of-the-Wasatch, College of, at Salt Lake City, Utah; Roman Catholic; for women; founded 1926; arts and sciences.

Saint Mary-of-the-Woods College, at Saint Mary-of-the-Woods, Ind.; Roman Catholic; for women; founded 1840; arts and sciences, art, education, home economics, journalism, music

St. Mary Redcliffe, famous old church in Bristol, England B-312

St. Marys, Md., first settlement and early capital of state; on St. Marys River, 55 mi. s. of Annapolis; founded 1634.

St. Mary's College, at Notre Dame, Ind.; Roman Catholic; for women; founded 1844; arts and sciences, theology; graduate studies.

St. Mary's College, at Winona, Minn.; Roman Catholic; for men; founded 1913; arts and sciences.

St. Mary's College of California, near Oakland, Calif.; Roman Catholic; for men; founded 1863; arts and letters, economics and business administration, science.

Saint Mary's Dominican College, at New Orleans, La.; Roman Catholic; for women; incorporated 1910; arts and sciences, business, education, home economics; physical education.

St. Marys River, or **St. Mary River** (St. Mary official name in Canada), channel linking Lakes Superior and Huron S-49, *map* M-226, *picture* S-50

St. Marys River, Ga., rises in Okefenokee Swamp; forms part of boundary between Georgia and Florida; 175 mi. long: *maps* G-70, 77

St. Mary's University of San Antonio, at San Antonio, Tex.; Roman

Catholic; opened 1852; arts and sciences, business, music, law.

St. Matthew Island, in Bering Sea, Alaska, *maps* A-135, N-250

'St. Matthew Passion', musical composition by Bach M-461

St. Maur, English family. *See in Index* Seymour

St. Maurice River, Quebec, Canada, tributary of the St. Lawrence; 350 mi. long: *map* C-72

St. Michael, island of the Azores. *See in Index* São Miguel

St. Michael and St. George, Order of, a British order of knighthood D-43

St. Michael's College, at Winooski Park, Vt.; Roman Catholic; for men; founded 1904; arts and sciences; graduate studies.

Saint-Mihiel (*săṅ-mē-yĕl'*), town in n. France, 20 mi. s. of Verdun on Meuse River; pop. 4134: S-22–3, W-238, *maps* W-232–3, 224, E-425

St. Moritz (*sānt mō'rĭts*), Switzerland, loftiest village in Upper Engadine, on Lake Moritz; pop. 2558; mineral springs; popular and fashionable resort for winter sports: *maps* S-475, E-425

toboggan slide W-160

St. Nazaire (*săṅ nà-zâr'*), France, port on w. coast at mouth of Loire River; pop. 4408; locks used, because of shallow water, to convey boats to docks; shipbuilding yards; steelworks: *maps* F-259, E-416

'St. Nicholas' (*sānt nĭk'ō-lăs*), magazine for young people L-274–5

St. Nick. *See in Index* Nicholas, Saint

Saint-Nicolas (*săṅ-nē-kō-lä'*), Flemish Sint-Niklaas, Belgium, trade and manufacturing center, 12 mi. s.w. of Antwerp; pop. 43,994: *map* B-111

St. (sānt) Norbert College, at West De Pere, Wis.; Roman Catholic; for men boarding students; coeducational for day students; founded 1898; arts and sciences.

St. Olaf College, at Northfield, Minn.; Evangelical Lutheran; founded 1874; college from 1886; arts and sciences, economics, home economics, music.

St. Olaf's Day, Norway F-59

Saintonge (*săṅ-tôṅzh'*), historic French province, *map* F-270

Saint-Ouen (*săṅ-twăṅ'*), France, suburb n. of Paris on Seine River; pop. 45,360; river port and manufacturing center.

St. (sānt) Patrick, Order of, an Irish order of knighthood D-43

St. Patrick's Cathedral, Dublin D-157

St. Patrick's Cathedral, Roman Catholic, one of the largest cathedrals in America, in New York City, on Fifth Avenue; begun 1858, completed 1879; Gothic in architecture.

St. Patrick's cross

English flag F-136*a*, 136*c*, *color pictures* F-131, 133

Hawaiian flag F-130, *color picture* F-126

St. Patrick's Day P-97, 98

shamrock worn S-133

St. Patrick's Seminary, at Menlo Park, Calif.; Roman Catholic; for men; opened 1898; arts and sciences, theology.

Saint Paul, Minn., state capital, on Mississippi River; pop. 311,349: S-23–4, *maps* M-287, U-253, *picture* S-23

Capitol, State S-24, *picture* M-277

Saintpaulia (*sānt-pô'lĭ-a*), or **African-violet**, a hairy perennial plant (*S. ionantha*) of the gesneria family, used as a house plant. Stemless plant with oval, hairy, toothed, dark-green leaves; flowers one inch across, unscented, deep violet with yellow pistil.

St. Paul's, cathedral in London, England L-298, 301, A-319, *map* L-301, *picture* L-302

choir stalls, *picture* W-190*a*

famous bell B-121

Saint Paul Seminary, at St. Paul, Minn.; Roman Catholic; for men; chartered 1895; opened 1895; arts and sciences, theology; graduate study.

St. Paul's Polytechnic Institute, at Lawrenceville, Va.; controlled by Protestant Episcopal church; for Negroes; founded 1888; teacher, business, and technical education.

St. Paul's Rocks, or **St. Paul Rocks**, small Brazilian island in central Atlantic just n. of equator; submerged mountain peak.

St. Paul's School, famous boys' preparatory school at Concord, N. H.; founded 1855; Protestant Episcopal; publishes *Horae Scholasticae*, oldest school paper in U. S.

St. Peter and St. Paul, Cathedral Church of, also **Washington Cathedral**, popularly known as **The National Cathedral**, at Washington, D. C., on Mt. St. Alban; Episcopal; Gothic architecture; area 75,000 sq. ft.; length 525 ft.; cornerstone laid 1907; first portion, Bethlehem Chapel, opened for public worship 1912; almost half completed 1950

Woodrow Wilson buried W-149

St. Peter's, church in Rome, Italy R-196, *map* R-190, *pictures* R-189, 192, 194, P-65

cypress doors C-534

dome designed by Michelangelo M-214, *picture* A-316

interior, *picture* A-313

Julius II builds J-364

Michelangelo's 'Madonna della Pietà', M-213, *picture* M-213

Saint Petersburg, Fla., winter resort on Tampa Bay; pop. 96,738: S-24, F-164, *maps* F-159, U-253

St. Petersburg, Russia. *See in Index* Leningrad

St. Peter's College, at Jersey City, N. J.; Roman Catholic; for men; founded 1872; arts and sciences, business administration.

Saint-Pierre, Bernardin de. *See in Index* Bernardin de Saint-Pierre

Saint Pierre (*săṅ pyêr*), formerly the chief town of Martinique; pop. 6218: M-104, *map* W-96*a*

St. Pierre and Miquelon (*mē-klôṅ'*), French overseas territory consisting of several barren rocky islands 10 mi. off s. coast of Newfoundland; 93 sq. mi.; pop. 4354; codfishing center seized by Free French December 1941; plebiscite voted fealty to Free French: *map* C-69

St. Privat (*prē-vä'*), a village in n.e. France, near Metz; scene of one of the actions of the battle of Gravelotte (1870).

Saint-Quentin (*săṅ-kăṅ-tăṅ'*), city in n. France on Somme River, 95 mi. n.e. of Paris; pop. 46,876; situated in sheep-grazing country; textile center since Middle Ages; curtains, embroideries; also light iron products, machinery, chemicals; notable 12th-century cathedral and thousands of other buildings damaged in fierce battles during World War I; cathedral reopened 1920; city named for 3d century martyr; early seat of counts of Vermandois; captured by Spaniards 1557, by Germans 1871, 1914, and 1940: *maps* B-111, W-217, E-425

St. Roque (*sānt rōk*), **Cape**, Portuguese **São Roque** (*souṅ rō'kĕ*), on n.e. coast of Brazil; nearest point to Africa, 1600 miles: *maps* B-288, S-256

St. Rose, College of, at Albany, N.Y.; Roman Catholic; for women; founded 1920; arts and sciences, education, nursing; graduate division.

Saint-Saëns (*săṅ-săṅs*), **Charles Camille** (1835–1921), French composer, pianist and organist; received first recognition with brilliant symphonic poems, 'Phaëton', 'La danse macabre', 'La jeunesse d'Hercule'; of his operas, 'Samson and Delilah' is most successful; instrumental works of consummate skill

'Samson and Delilah', story O-393

Saintsbury (*sānts'bĕr-ĭ*), **George Edward Bateman** (1845–1933), English literary critic and historian ('A History of Criticism'; 'A History of English Prosody').

St. Scholastica, College of, at Duluth, Minn.; Roman Catholic; for women; founded 1912; arts and sciences, nursing, music.

Saints' days F-59

Saint-Simon (*săṅ-sē-môṅ'*), **Claude Henri de Rouvroy, comte de** (1760–1825), founder of French Socialism S-215

Saint-Simon, Louis de Rouvroy, duc de (1675–1755), French writer, born Paris; his 'Memoirs' important source of information on reign of Louis XIV.

St. Simon Island (*sānt sī'mŭn*), island of Georgia, in St. Simon Sound, s. of entrance to Altamaha River; area, about 15,000 acres; ruins of Fort Frederica, lighthouse, Redfern air field

Saints of North America, Jesuit missionaries martyred in early 17th century while trying to convert American Indians; Fathers Isaac Jogues, Jean de Brébeuf, Noël Chabanel, Antoine Daniel, Charles Garnier, Gabriel Lalemant; Brothers Jean de Lalande and René Goupil; canonized June 29, 1930.

St. Sophia (*sō-fē'ą*), famous cathedral in Kiev, Russia K-39, R-284

St. Sophia, or **Santa Sophia**, Greek **Hagia Sophia** (*hä'yä' sō'fē'ä'*), meaning "holy wisdom," building at Istanbul, erected as a Christian church in the 6th century by the emperor Justinian I; became a Mohammedan mosque in 1453; in 1935 was made a museum of Byzantine antiquities: A-310, I-258, *pictures* A-309, A-410

mosaics, *picture* A-313

Turks take B-374

St. Stephen's, cathedral in Vienna, Austria; architecture largely Gothic; almost demolished in World War II; restoration begun in 1946, completed 1952: V-472

St. Sulpice (*săṅ sül-pēs'*), **Grand Seminary of**, at Montreal, Canada; Roman Catholic theological school affiliated with University of Montreal; founded 1657; earliest school in Montreal.

St. Sylvester, Order of. *See in Index* Order of St. Sylvester

Saint (sānt) Teresa, College of, at Kansas City, Mo.; Roman Catholic; for women; incorporated 1940; arts and sciences.

St. Teresa, College of, at Winona, Minn.; Roman Catholic; for women; founded 1911; arts and sciences.

St. Thomas, one of Virgin Islands (U. S.); 32 sq. mi.; pop. 13,813; U. S. naval and air base: V-493, *map*, *inset* W-96*a*

Charlotte Amalie harbor, *picture* W-93

St. Thomas, Portuguese island. *See in Index* São Tomé
St. Thomas, Ontario, Canada, industrial and railroad center 15 mi. s. of London and 8 mi. n. of Lake Erie; pop. 18,173; ships farm products and fruit; r.r. shops; iron and steel products, shoes, knit goods, woodenware: *maps* C-72, *inset* C-68
St. Thomas, port of Virgin Islands. *See in Index* Charlotte Amalie
St. Thomas, College of, at St. Paul, Minn.; Roman Catholic; for men; founded 1885; arts and sciences, business administration, education, fine arts, religion, social sciences; coeducational in graduate studies.
Saint Valentine's Day S-24
Saint-Valéry-sur-Somme (*săṅ-và-lā-rĕ'sür-sôm'*), small port and fishing community of France, at mouth of Somme River; pop. 2647.
St. Vincent (*sānt vĭn'sĕnt*), one of Windward Islands, West Indies; 133 sq. mi.; pop. 57,168; with n. Grenadines (17 sq. mi.; pop. 4479) it forms British colony of St. Vincent (area 150 sq. mi.; pop. 61,647); cap. Kingstown; arrowroot, cassava, coconuts, cotton: *maps* V-442, W-96*a*
St. Vincent, also **São Vicente** (*souṅ vē-sēṅ'tĕ*), Portuguese island of Cape Verde group, off n.w. coast of Africa; 75 sq. mi.; pop. 15,848; cable station: *map, inset* A-47
St. Vincent, Cape, also **São Vicente**, promontory on s.w. tip of Portugal; British fleet under Jervis and Nelson defeated Spanish fleet 1797: *maps* S-312, E-425
St. Vincent College, at Latrobe, Pa.; Roman Catholic; for men; founded 1846; arts and sciences; graduate school.
St. Vincent de Paul, Society of, a Roman Catholic charitable society, founded by Antoine Frédéric Ozanam (1813–53), a French scholar; first established in U.S. in 1845, at St. Louis, Mo.
St. Vitus's dance, in Middle Ages D-14*e*
Saionji (*sī-yōn'jē*), **Kimmochi** (*kēm-mō'chē*), **Prince** (1849–1940), Japanese statesman, born Kyoto; minister to Austria 1885, to Germany 1888; minister of education 1892–96, 1898; premier 1905–7, 1910–12; president of the Seiyukai party 1903; political adviser to Emperor Hirohito.
Saipan (*sī-păn'*), second largest island of Mariana group in w. Pacific; 70 sq. mi.; pop. 4943; in 1919 mandated to Japan, which used it as military outpost; conquered by American forces July 1944; transformed into naval and air base: W-267, *maps* P-16, J-297
Sair, a wild sheep S-136
Sakai (*sä'kī*), a race of the Malay Peninsula M-59, *picture* M-58
Sakakawea. *See in Index* Sacajawea
Sakartvelo. *See in Index* Georgia (Russia)
Sake (*sä'kē*), national drink of Japan made from rice; fermented with yeast cake called *koji*; yellowish; 12 to 15 per cent alcohol.
Sakhalin (*săk'a-lēn*), formerly **Saghalin**, long, mountainous island of Russia near e. coast of Siberia; 24,560 sq. mi.; pop. about 500,000; s. part (Karafuto) ceded to Japan by Russia, 1905, after Russo-Japanese War; returned to Russia after World War II; forests, fisheries, coal, oil: *maps* R-259, J-297, A-406
Saki. *See in Index* Munro, Hector Hugh
Saki (*sä'kē*), a South American monkey M-351, *picture* M-349
Sakiu (*săk'ĭ-ạ*), a water wheel used in Egypt E-275, *diagram* E-274, *picture* E-274
Sakkara, Egypt. *See in Index* Saqqara
'Sakuntala' (*sŭ-kọn'tŭ-lä*), or **'Shakuntala'**, Sanskrit drama by Kalidasa. Sakuntala is found in her forest home by King Dushyanta, who marries her and gives her a ring by which he is to recognize her when she joins him at his palace; the ring is lost and the king disowns her, but proclaims her his queen when the ring is found. Story used in Goldmark's opera.
Sal'adin (1138–98), chivalrous Mohammedan leader, sultan of Egypt and Syria S-25
built citadel in Cairo C-15
burial place D-12
Crusade against C-520
Richard I and R-149
Scott's 'The Talisman' depicts S-25
Salado (*sä-lä'thō*), name of several rivers in South America
Salado del Norte A-332, *map* A-331
Salajar, island, Indonesia. *See in Index* Salayar
Salaman'ca, old Spanish city 110 mi. n.w. of Madrid; pop. 80,239, with suburbs; beautiful medieval buildings badly damaged in Spanish civil war: S-319, *maps* S-312, E-416
battle (1812). *See in Index* Battles, *table*
university S-319, U-404: Columbus presents his plan, *picture* C-418
Sal'amander, an amphibian S-25–6, *pictures* S-25, 26
hibernation S-25
lizard mistaken for L-281–2
Salamaua, settlement on e. coast of Northeast New Guinea s. of Lae, *maps* E-203, P-16
World War II W-262
Salambria, river in Greece. *See in Index* Salamvria
Salamis (*săl'a-mĭs*), Greece, barren mountainous island in Gulf of Aegina, or Saronic Gulf; 36 sq. mi.; famous for defeat of Persian fleet by Greeks in strait between island and Attic coast (480 B.C.): *map* G-197
Salamis, battle of (480 B.C.) S-26, P-159, *color picture* S-27
Aristides at A-339
Solon urges capture S-233
'Salammbô' (*sà-läm-bō'*), novel by Gustave Flaubert dealing with Carthaginian history; heroine Salammbô is the daughter of Hamilcar Barca, Carthaginian general.
Sal ammo'niac, or **ammonium chloride** A-236
in electric dry cell B-80, *diagram* B-79
Solvay process produces S-226
Salamvria (*sạ-läm'vri-a*), also **Salambria**, ancient **Peneus** (*pē-nē'ŭs*), modern Greek **Peneios** (*pē-nyē-ôs'*), chief river of Thessaly, Greece; 100 mi. long: *map* G-189
Salandra (*sä-län'drä*), **Antonio** (1853–1931), Italian statesman; as premier, responsible for Italy's early neutrality and later siding with Allies in World War I; author of books on political economy.
Salangane (*săl'ăn-gān*), an oriental swift
edible nest S-459
Sal'ary
derivation of word S-31
high U. S. officials, *table* U-357; president P-408*a*
wages. *See in Index* Wages
"Salary grab," in U.S. history, popular term applied to an act to raise salaries of members of Congress, voted just before closing of Congress, 1873 (Grant's administration); so called because the incumbents whose terms were about to expire were benefited; called also "back pay grab."
Salayar, or **Salajar** (*sä-lä'yär*), long, narrow island, generally mountainous, in Indonesia, s. of Celebes; area 256 sq. mi.; pop. about 76,000; timber, coconuts, tobacco.
Salazar (*sà-lạ-zär'*), **Antonio de Oliveira** (born 1889), dictator of Portugal P-381
Saldanha man M-70
Sal effervescens. *See in Index* Effervescent salt
Sa'lem, Mass., historic city 13 mi. n.e. of Boston on Atlantic; pop. 41,880; State Teachers College; Peabody Museum (colonial relics): *map, inset* M-132
Hawthorne associations H-294, *pictures* M-130
origin of name M-124
Roger Williams expelled W-140
Salem Maritime Historic Site N-20
witchcraft persecutions W-180
Salem, Ohio, city 62 mi. s.e. of Cleveland; pop. 12,754; coal-mining, farming, and stock-raising region; automobile bodies, pumps; served as "underground railroad" station before Civil War: *map* O-356
Salem, Ore., state capital, 43 mi. s. of Portland on Willamette River; pop. 43,140: S-26, *maps* U-252, *inset* O-416
Capitol, State, *picture* O-419
Salem College, at Winston-Salem, N.C.; for women; founded 1772 by Moravian church; arts and sciences, music.
Saleratus. *See in Index* Sodium, *subhead* bicarbonate
Salerno (*sä-lĕr'nō*), Italy, port on Gulf of Salerno s.e. of Naples; pop. 41,925; textiles; famous medieval medical school: *map* E-425, *picture* I-270
university U-404
World War II, battle W-279
Sales, Saint François de. *See in Index* François de Sales, Saint
Sales tax T-24*b*
Sal'ford, England, borough of Lancashire, practically a suburb of Manchester; pop. 178,036; cotton, iron, chemicals: *map, inset* B-324
Salian line, or **Franconian line**, of German emperors. *See in Index* Franconian line
Salians, division of Franks; pushed southward from homeland between Scheldt and Meuse as Roman power weakened; under Clovis (465–511) took all Gaul west of Loire and secured dominance of Franks.
Salicaceae. *See in Index* Willow family
Salicin (*săl'ĭ-sĭn*), drug obtained from willow W-143
Salic law, an early medieval law (one of the Germanic laws) of the Salian Franks, an important Frankish tribe; used as early as time of Clovis; a penal code with some rules of civil law which contain provisions against female inheritance of property; gave rise to so-called Salic law, enforced in France and various French and German kingdoms and duchies, which forbade succession to rule to females and to descendants through any female line
Victoria kept from throne of Hanover H-260
Salicylic (*săl-ĭ-sĭl'ĭk*) **acid**, an antipyretic (fever-allaying) drug ($C_6H_4 \cdot OH \cdot COOH$)
formula, *diagram* O-424*a*
made from carbolic acid C-371
Salina (*sa-lī'nạ*), Kan., railroad city on Smoky Hill River, 105 mi. w. of Topeka; pop. 26,176; ships grain; flour, farm machinery; Kansas

GUN SALUTES—UNITED STATES

48 guns. Salute to the Union, commemorative of the Declaration of Independence. One gun for each state is fired at noon July 4 at every U. S. military post and on board every U. S. commissioned naval vessel.

21 guns. Salute given to national flag; president of the U. S.; ex-presidents of the U. S.; presidents and sovereigns of foreign countries; and members of royal families.

19 guns. Salute given to vice-president of the U. S.; members of U. S. Cabinet (including deputy secretary of defense and the secretaries of army, navy, and air force); president pro tempore of U. S. Senate; foreign ambassadors; and the chief justice of U. S. Supreme Court.

17 guns. Salute given to assistant secretary of defense and the under- and assistant secretaries of army, navy, and air force; governors or viceroys of territories of foreign powers; speaker of U. S. House of Representatives; a committee of Congress; chairman, joint chiefs of staff; army, navy, and air force chiefs of staff; former chiefs of staff; generals of the army and generals of the air force; generals in the army and air force; fleet admirals and admirals in the navy; and foreign officers with corresponding ranks.

15 guns. Salute given to territorial vice-governors; American envoys and ministers plenipotentiary; foreign envoys and ministers plenipotentiary accredited to the U. S.; lieutenant generals in the army and air force; vice admirals in the navy; and foreign officers with corresponding ranks.

13 guns. Salute given to American ministers resident; foreign ministers resident accredited to the U. S.; major generals in the army and air force; rear admirals in the navy; and foreign officers with corresponding ranks.

11 guns. Salute given to American chargés d'affaires; foreign chargés d'affaires accredited to the U. S.; brigadier generals in the army and air force; commodores in the navy; foreign officers with corresponding ranks; consuls general of the U. S.; and foreign consuls general.

7 guns. Salute given to consuls of the U. S. and foreign consuls to the U. S.

5 guns. Salute given to vice-consuls of the U. S.; foreign vice-consuls; and consular agents of the U. S. and foreign powers.

Key: cāpe, ăt, fär, fȧst, whạt, fạll; mē, yĕt, fērn, thêre; īce, bĭt; rōw, wŏn, fôr, nŏt, dọ; cūre, bŭt, rụde, fụll, bûrn; out;

tragedy by Byron. *See also in Index* Assurbanipal
Sardes, Asia Minor. *See in Index* Sardis
Sardines', a game G-8*e*
Sardines, or pilchards, food fish S-44, P-256
Sardin'ia, Italian island in Mediterranean w. of Italy; 9299 sq. mi.; pop. 1,273,714: S-44–5, *maps* I-262, E-416, 419, 425, *pictures* S-44–5
  sardines named for S-44
  sheep S-136
  Tirso Dam, *picture* S-44. *See also in Index* Dam, *table*
Sardinia, kingdom of S-45, C-514
Sardis (*sär'dis*), or **Sardes**, capital of ancient Lydia, Asia Minor; flourished under Croesus; destroyed by Timur (A.D. 1402); important recent excavations: *maps* G-197, P-156
  burning leads to Persian Wars P-158
  Croesus' court at C-515
  siege (558 B.C.). *See in Index* Siege, *table*
Sardis Dam, in Mississippi, on Little Tallahatchie River, *map* M-302. *See also in Index* Dam, *table*
Sardonyx (*sär'dō-niks*), a semiprecious stone J-350
Sardou (*sȧr-do'*), **Victorien** (1831–1908), French dramatist, dexterous and prolific ('Fédora'; 'Madame Sans-Gêne'; 'La Tosca').
Sarett, Lew (1888–1954), poet, born Chicago, Ill.; woodsman, forest ranger, teacher at Northwestern University 1920–53; his poems ('Many, Many Moons'; 'Wings Against the Moon'; 'Slow Smoke') have tang of campfire and sagebrush.
Sarg, Tony (**Anthony Frederick**) (1882–1942), American artist, born Guatemala, son of German plantation owner and English mother; creator of "Tony Sarg's Marionettes," also illustrator, cartoonist, and mural artist; author of books for children: P-441
Sargas'so Sea (from the Portuguese word for gulfweed), region in the n. Atlantic S-94
  eels breed in E-267, 268
  ocean currents O-335, *map* O-335
  weed fish, *color picture* P-420*b*
Sargassum fish, or **mousefish**, surface fish (*Histrio pictus*), inhabiting the Sargasso Sea; fantastic in shape; olive brown with black markings.
Sargent, Charles Sprague (1841–1927), authority on trees, born Boston, Mass.; professor of arboriculture Harvard University
  director of Arnold Arboretum B-262
Sargent, Dudley Allen (1849–1924), specialist in physical education, born Belfast, Me.; influential in the development of physical training in American schools; 1881 organized Sanatory Gymnasium at Cambridge, Mass., later named Sargent School for Physical Education.
Sargent, John Singer (1856–1925), American painter, born Florence, Italy S-45–6, *picture* S-46
  'Frieze of the Prophets', *picture* P-419
Sargent, Walter (1868–1927), painter and educator, born Worcester, Mass.; professor art education, University of Chicago 1909–27 ('The Enjoyment and Use of Color').
Sar'gon I (about 2350 B.C.), king of Babylonia, founder of first great nation in w. Asia B-7
Sargon II (reigned 722–705 B.C.), king of Assyria; usurped throne and took name of Sargon, the Babylonian king, from whom he claimed descent; built city of Dur Sharrukin, near present village of Khorsabad: B-8–9, *picture* B-7
  palace B-9: plaster decoration from, *picture* B-7; winged bulls from, *picture* B-8
Sari, costume worn by women in India and Pakistan I-60–1, P-42*b*, *pictures* I-56–7, 59, 61
Sar'ikol Range, mountains on e. edge of Great Pamir; w. border of Sinkiang; rise but little above Pamir; form center from which great ranges of central Asia diverge.
Sark (*särk*), French **Sercq** (*sĕrk*), one of the Channel Islands; 2 sq. mi.; pop. 553; famous cliffs, caves; C-185, *map* B-325
Sarmiento (*sar-myĕn'tō*), **Domingo Faustino** (1811–88), president of Argentina 1868–74
  education promoted by A-336, L-114
Sar'nia, Ontario, Canada, port on Lake Huron and St. Clair River; connected with Port Huron, Mich., by Blue Water International Bridge, railroad tunnel, and ferry service; pop. 34,697; oil, salt, lumber, iron and steel products; natural gas, grain elevators: *maps* C-69, 72
  synthetic rubber plant, *picture* O-386
Sarnoff, David (born 1891), American businessman, born Russia; brought to U. S. when 9 years old; started working for Marconi Co. in 1906, for Radio Corporation of America (which absorbed Marconi Co.) in 1919; made president of R.C.A. 1930.
Sarong (*sȧ-rŏng'*), in dress
  Bali, *pictures* E-208
Saron'ic Gulf, also **Gulf of Aegina**, or **Egina**, arm of Aegean Sea on e. coast of Greece, *map* G-189
Saros, The, interval of time, 18 years and 11.32 or 10.32 days (depending upon the number of leap years in the period), in which similar solar eclipses appear. Discovered by the Chaldeans from their observations of eclipses. Usually about 71 solar eclipses in the interval.
Saroyan (*sȯr-ō'yăn*), **William** (born 1908), author, born near Fresno, Calif., on grape ranch of his Armenian father; stories subjective, spontaneous, tender ('The Daring Young Man on the Flying Trapeze'; 'My Name Is Aram'; 'The Human Comedy'); plays original in technique ('My Heart's in the Highlands'; won 1940 Pulitzer prize with 'Time of Your Life'; 'Love's Old Sweet Song').
Sarpedon (*sȧr-pē'dŏn*), legendary king of Lycia, son of Zeus and Europa; also name of his grandson, an ally of the Trojans in the Trojan War, who was slain by Patroclus.
Sarpi (*sär'pē*), **Paolo** (1552–1623), Venetian scholar and historian; entered Servite order at 13; close student of mathematics, Oriental languages, philosophy, theology, anatomy; made adviser (1606) to Venetian republic and led fight against Pope Paul V ('History of the Council of Trent').
Sarracenia, sidesaddle plant genus P-274
Sarsaparil'la S-46
Sarsi (*sȧr'sē*), or **Sarcee**, an Athabascan Indian tribe in n. Canada.
Sarts, a mixed people of Turkestan, of Arab and other elements; engaged in trade; Mohammedans.
Sartain (*sär-tān'*), **John** (1808–97), English engraver and editor, born London; came to America 1830; introduced mezzotint engraving into America; his daughter Emily and son Samuel also became distinguished engravers.
Sar'to, Andrea del (1486–1531), Italian painter, born near Florence, Italy; called "del Sarto" because father was a tailor; a superb colorist; known for frescoes (notably 'Nativity of the Virgin' at Florence) and oils ('Holy Family' and 'Charity' at Louvre in Paris)
  painting, *picture* M-238*c*
'Sar'tor Resar'tus' ("the tailor retailored"), work by Carlyle C-122
Sartre, Jean Paul (born 1905), French philosopher and author, born Paris; taught philosophy in lycées at Le Hâvre and Paris; leading Existentialist; novels ('Nausea'; 'Age of Reason'), plays ('No Exit'; 'Unburied Dead'; 'Red Gloves'), philosophical treatise ('Being and Nonbeing'; 'What Is Literature?').
Sarum, parish in England. *See in Index* Old Sarum
Sash. *See in Index* Architecture, *table* of terms
Saskatch'ewan, a prairie province of Canada; 251,700 sq. mi.; pop. 831,728; cap. Regina: S-46–9, *maps* C-68, 81, *pictures* S-47–8
  cities, *list* S-46. *See also in Index* names of cities
    Regina R-96, *picture* R-96
  climate S-47
  education S-48
  government S-48
  minerals S-48, 49
  natural features S-46, 47, *list* S-46
  occupations, *pictograph* C-66
  parks, *map* N-38*f*: Fort Battleford National Historic Park N-39; Prince Albert National Scenic and Recreational Park N-38*f*
  products S-47, 48, *list* S-46: wheat C-85, *picture* C-70
  shield F-136*a*, *color picture* F-131
Saskatchewan, University of, at Saskatoon, Saskatchewan, Canada; provincial control; founded 1907; arts and sciences, agriculture, commerce, education, engineering, home economics, law, medicine, nursing, pharmacy; graduate studies.
Saskatchewan River, Canada, a river formed by union of N. and S. Saskatchewan branches near Prince Albert, Saskatchewan; flows 240 mi. e. to Lake Winnipeg: S-47, *maps* C-81, N-245
Saskatoon', city of Saskatchewan, 82 mi. s. of Prince Albert; distributing point for grain and cattle; pop. 53,268; flour, cereals, foundry products, machinery; University of Saskatchewan, normal school, forestry station: S-47, *maps* C-68, 81
Sas'safras, a tree S-49, T-184
Sassafras Mountain, highest point in South Carolina, in n.w. (3560 ft.), *maps* S-290, 283
"Sassafras tea" T-33
Sas'sanid Dynasty, last native dynasty of ancient Persia (A.D. 226–637) P-157, M-175
Sassari (*säs'sä-rē*), Italy, province in n. Sardinia; also name of its capital (pop. 70,324, with suburbs) *maps* I-262, E-425
Sassetta (*sä-sät'tä*), **Stefano di Giovanni** (1392–1450?), Italian painter, called "one of the noblest and tenderest of the Sienese masters"; especially noted for his scenes from legend of St. Francis.
Sassoon', **Siegfried Lorraine** (born 1886), English poet; served in World War I in France and Palestine, but hated the bloodshed and brutalities and threw his Military Cross into the sea as a protest against war; best known for bitter

ŭ=French *u*, German *ü*; *ġem*, *ġo*; *th*in, *th*en: *ṅ*=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); *к*=German guttural *ch*

ü=French *u*, German *ü*; ġem, ġo; thin, *th*en; ṅ=French nasal (Jeaṅ); *zh*=French *j* (*z* in azure); *ĸ*=German guttural *ch*

Shepherd's clock. *See in Index* Pimpernel

Shepherds-scabious. *See in Index* Jasione

Sheppard, William Ludlow (1833–1912), sculptor and illustrator, born Richmond, Va.
painting of Confederate veteran, *picture* R-85

Sheppard fish, a purplish to bluish fish, found in the open ocean; family *Nomeidae*
Portuguese man-of-war and F-105

Sher'aton, Thomas (1751?–1806), English furniture designer
furniture I-178, *picture* I-183

Sher'brooke, Quebec, Canada, port, industrial city at confluence of Magog and St. Francis rivers, 85 mi. e. of Montreal; pop. 50,543; textiles, machinery, scales; St. Charles and Bishop's colleges: *maps* C-69, 73

Shere Ali (*shēr ȧ-lē'*) **Khan** (1825–79), amir of Afghanistan; defeated in war with Great Britain (1878) and dethroned.

Shere Khan, the Tiger, in Kipling's story of Mowgli K-48

Sher'idan, Philip Henry (1831–88), American Civil War general S-146–7, C-336, *picture* S-147
grave N-16*b*
in state of Washington W-38

Sheridan, Richard Brinsley (1751–1816), British wit, dramatist, and statesman, friend and ally of C. J. Fox; member of Dr. Johnson's famous literary club ('The School for Scandal'; 'The Rivals')
hostility to Hastings H-280
plays characterized D-133

Sheridan, Wyo., city near n. border; pop. 11,500; dude ranch district; Northeast Agricultural Junior College: W-326, *maps* W-323, U-252

Sheriff, in the U.S., chief executive officer of a county; charged with maintaining the peace, executing laws, and serving judicial writs.

Sherlock Holmes, in A. Conan Doyle's detective stories, marvelous amateur detective who unravels the most baffling mysteries.

Sherman, Forrest P(ercival) (1896–1951), U.S. Navy officer, born Merrimack, N. H.; chief of staff Pacific fleet air force 1942–43; deputy chief of staff to Admiral Nimitz 1943–45; coauthor armed services unification act 1947; commander U. S. Mediterranean fleet 1948–49; chief of naval operations 1949–51.

Sherman, James Schoolcraft (1855–1912), vice-president of the United States 1909 to death; born Utica, N. Y.; in U. S. Congress 1887–91, 1893–1909.

Sherman, John (1823–1900), financier and statesman, born Lancaster, Ohio; younger brother of Gen. W. T. Sherman; U. S. senator from Ohio 1861–77, 1881–97; as secretary of treasury (1877–81) under Hayes, provided for resumption of specie payments in 1879: H-297, *picture* H-276
Anti-Trust Act H-275, M-360
secretary of state M-19
Silver Purchase Act H-275–6

Sherman, Roger (1721–93), American Revolutionary War statesman; member of committee that drew up Declaration of Independence; in Federal Constitutional Convention helped reconcile large-state and small-state parties; signed United States Constitution for Connecticut; was also member of Connecticut legislature, judge of state superior court, representative in Congress, and U. S. senator: *picture* R-120
Declaration of Independence D-33: signature reproduced D-37
Statuary Hall. *See in Index* Statuary Hall (Connecticut), *table*

Sherman, Stuart Pratt (1881–1926), literary critic, born Anita, Iowa; professor English, University of Illinois; literary editor, *New York Herald Tribune* ('Matthew Arnold'; 'On Contemporary Literature'; 'The Genius of America').

Sherman, William Tecumseh (1820–91), American Civil War general S-147–8, *picture* S-147
Atlanta A-451, C-336
battle of Chattanooga C-199, *map* C-199
Hall of Fame, *table* H-249
Johnston surrenders to N-280
march to the sea S-148
quoted on Kit Carson C-128*b*
South Carolina S-294

Sherman, Tex., industrial and trade city in Red River valley, 55 mi. n. of Dallas; pop. 20,150; cotton, livestock, and farming district; cotton products, flour, clothing, hosiery, boxes; nurseries: railroad shops; Austin College: *maps* T-90, U-253

Sherman, General, famous sequoia tree S-102, N-38*b*, *picture* C-41

Sherman Anti-Trust Act, U. S. H-275, M-360

Sherman Silver Purchase Act, U. S. H-275–6

Sherriff, Robert Cedric (born 1896), English playwright; wounded at Ypres in World War I ('Journey's End', a war play with only male characters).

Sherrington, Sir Charles Scott (1857–1952), English physiologist; shared 1932 Nobel prize in medicine and physiology with Edgar Douglas Adrian for their discoveries concerning function of neuron ('Integrative Action of the Nervous System'; 'Mammalian Physiology'; 'Man on His Nature').

Sherry wine, originally made from grapes grown near Jerez de la Frontera, Spain, hence its name (old pronunciation of Jerez was *shä'räs* or *shĕr'ĕs*); dry and sweet varieties; used as a table wine, also in cooking.

's Hertogenbosch (*sĕr'tō-ᴋĕn-bōs*), French **Bois-le-Duc** (*bwä-lē-dük'*), Netherlands, city 50 mi. s.e. of Amsterdam; pop. 53,208; noted cathedral; manufacturing, shipping.

Sherwani (*shĕr'vä-nī*), knee length coat worn by Indian and Pakistani men I-61, P-42*b*

Sherwood, Robert Emmet (born 1896), playwright and biographer, born New Rochelle, N. Y. (Pulitzer prize for drama 1936 for 'Idiot's Delight', 1939 for 'Abe Lincoln in Illinois', 1941 for 'There Shall Be No Night'; 'The Road to Rome', 'The Queen's Husband', 'Reunion in Vienna', and 'The Petrified Forest' included among his other well-known dramas; Pulitzer prize for biography 1949 for 'Roosevelt and Hopkins'); chief, overseas branch of OWI 1942–44.

Sherwood Forest, England, hilly district in Nottinghamshire; former royal hunting forest, now largely divided into private parks and farms; retreat of Robin Hood.

Sherwood Forest, John Tyler's estate in Virginia T-227

She'shonk, or **Shi'shak I** (10th century B.C.), Egyptian king of 22d dynasty; captured and sacked Jerusalem, about 925 B.C., after death of Solomon.

'She Stoops to Conquer', comedy by Oliver Goldsmith in which heroine "stoops" to masquerade as maid in order to win bashful lover.

Shet'land Islands, group n.e. of Scotland, constituting a Scottish county; 550 sq. mi.; pop. 19,343: S-148, *map*, *inset* B-324

Shetland pony H-428*a–b*, *pictures* H-428*c*, P-185, *table* H-428*e*

Shetland sheep dog, *table* D-118*b*

Shetucket River, Conn., a stream uniting with the Quinebaug to form the Thames. *maps* C-438, 445

Sheyenne River, N. D., in e. part of state, flows 300 miles s.e. to Red River, *maps* N-282, 288–9

Shibusawa (*shē-bo̤-sä-wä*), **Eiichi, Baron** (1840–1931), Japanese banker and public leader, called Japan's "Grand Old Man"; active in cause of peace.

Shield, armor A-376, *color picture* S-27
ancient, *picture* B-328
heraldic devices H-341

Shield, in tunnel construction T-208–9

Shield, or **Canadian Shield**. *See in Index* Laurentian Plateau

Shield, or **coign**, in geology G-54, *diagram* G-54

Shielding, in radio R-40

Shields, James (1810–79), American soldier and political leader, born in Ireland; officer in Mexican War; governor of Oregon territory 1848–49; represented 3 states in United States Senate—Illinois, Minnesota, and Missouri; brigadier general in Civil War; defeated by Stonewall Jackson. *See also in Index* Statuary Hall, (Illinois), *table*

Shields, North, England, port on n. bank of Tyne River, near mouth, opposite South Shields; incorporated with adjacent Tynemouth.

Shields, South, England, port on s. bank of Tyne River; pop. 106,605; iron and shipbuilding center with supplemental shipping industries; enormous docks; exports coal: *map* B-324

Shih Huang-ti (259–210 B.C.), Chinese emperor of the Ts'in, or Ch'in, dynasty (249–207 B.C.); overthrew feudal system; set up centralized government over all China; took title of "First Emperor": C-278
Great Wall C-277, *picture* C-282

Shiites (*shē'īts*), branch of Moslems, chiefly in Indian peninsula and in Iran M-331

Shikoku (*shē-kō'ko̤*), one of principal islands of Japan; 7280 sq. mi.; pop. 4,220,285: *maps* J-297, A-406

Shillaber, Benjamin Penhallow. *See in Index* Partington, Mrs.

Shillelagh, also **shillaly** and **shillalah** (*shĭ-lā'lē*), a stout oak or blackthorn stick used as a club; named for a village in Ireland near an oak forest.

Shilling, a silver coin used in Great Britain and dependencies; historical value 12 pence or 1/20 pound; abbreviated *s.*

Shil'luk, a Negroid people of e. Sudan, Africa; tall, long-headed, but mostly with coarse features; a proud, brave people: *color picture* A-35

Shiloh (*shī'lō*), ancient town 20 mi. n. of Jerusalem; contained sanctuary of ark of the covenant: *map* B-138

Shiloh, or **Pittsburg Landing**, battle of (1862), in American Civil War S-148, *map* C-334
Sherman at S-147

Shiloh National Military Park, Tenn., Civil War battle site and Indian mounds: established 1894.

Shimonoseki (*shĭm-ō-nō-sĕk'ĭ*), formerly **Akamagaseki** (*ä-kä-mä-gä-sē-kē*), also **Bakan** (*bä-kän*), Japan, seaport city on s.w. end of Honshu; pop. 193,572; railroad terminus and

SOME FAMOUS SIEGES OF HISTORY

Name	Date	Duration	
Adrianople	1912–13	155 days	Turks besieged by Bulgarians. Fell.
Alcazar, Toledo	1936	71 days	Fascists besieged by Loyalists. Raised.
Antioch	1097–98	9 months	Mohammedans besieged by Crusaders. Fell. Followed by a countersiege of the Crusaders by the Mohammedans. Raised.
Antwerp	1584–85	14 months	Belgians besieged by Spaniards under Prince of Parma. Fell.
	1830–32	15 months	Dutch garrison besieged by populace. Surrendered.
Arcot	1751	50 days	120 British and 200 Sepoys under Clive besieged by 150 French and 10,000 Sepoys. Raised.
Athens	431–421 B.C.	10 years	Besieged by Spartans. Intermittent sieges during crop season. Raised.
Candia	1648–69	more than 20 years	Venetians besieged by Turks. Fell.
Carthage	148–146 B.C.	2 years	Carthaginians besieged by Romans. Fell.
Constantinople	673–677	5 years	Byzantines besieged by Saracens. Raised.
	717–718	1 year	Same as above.
	1453	54 days	Byzantines besieged by Turks. Fell.
Delhi	1857	131 days	Indian mutineers besieged by British. Fell.
Gibraltar	1779–83	3 yrs., 7 mos., 12 days	British garrison besieged by Spaniards and Frenchmen. Raised.
Haarlem	1572–73	206 days	Dutch besieged by Spaniards under Don Frederic. Surrendered.
Jerusalem	A.D. 70	5 months	Jews besieged by Roman legions under Titus. Fell.
	637	4 months	Mohammedans led by Omar invested Byzantine forces. Fell.
	1099	2 (?) months	Mohammedans besieged by Crusaders. Fell.
	1917	1 day	Turks besieged by British under Allenby. Fell.
Ladysmith	1899–1900	118 days	Boers besieged British. Relieved.
La Rochelle	1627	1 year	Richelieu besieged French Huguenots. Fell.
Leningrad	1941–44	2 years, 5 months	Germans besieged Russians. Completely blockaded for 17 months, city remained under fire a year longer. Lifted.
Leyden	1574	4 months	Spaniards besieged Dutch. Raised after Dutch cut dikes.
Lucknow	1857	149 days	British under Lawrence, later under Havelock, besieged by Indian mutineers. Relieved.
Madrid	1936–39	29 months	Loyalists besieged by Fascists. Surrendered.
Mafeking	1899–1900	217 days	Boers besieged British garrison under Baden-Powell. Relieved.
Mantua	1796–97	8 months	Napoleon besieged Austrians. Fell.
Orléans	1428–29	10 months	French besieged by English. Relieved by Joan of Arc.
Ostend	1601–4	3 years	Flemish besieged by Spanish. Surrendered.
Paris	1870–71	135 days	Besieged by Germans. Surrendered.
Petersburg	1864–65	290 days	Confederates besieged by Federals. Evacuated.
Plevna	1877	144 days	Turks besieged by Russians and Rumanians. Surrendered.
Port Arthur	1905	241 days	Russian garrison surrendered to Japanese.
Przemysl	1914–15	185 days	Russians besieged Austrians under Kusmanek. Surrendered.
Sardis	558 B.C.	14 days	Lydians besieged by Persians under Cyrus the Great. Fell.
Sevastopol	1854–55	335 days	Russians besieged by Allies. Fell.
Stalingrad	1942–43	162 days	Russians besieged by Germans. Lifted.
Syracuse	214–212 B.C.	2 years	Besieged by Romans under Marcellus. Fell.
Torres Vedras	1810–11	7 months	British under Wellington held off advance of Napoleonic troops under Masséna. Raised.
Troy	12th or 13th century B.C.	10 years	Greeks besieged Trojans. Fell.
Tyre	585–572 B.C.	13 years	Besieged by Nebuchadnezzar II. Raised.
	332 B.C.	7 months	Besieged by Alexander the Great. Fell.
Vicksburg	1863	47 days	Confederates besieged by Federals under Grant. Fell.
Vienna	1683	58 days	Besieged by Turks. Relieved by John Sobieski. Raised.

See also in Index Battles, *table*

Key: cāpe, ăt, fär, fȧst, whạt, fạll; mē, yĕt, fērn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, dọ; cūre, bŭt, rụde, fụll, bûrn; out;

Key: cāpe, ăt, fär, fȧst, whạt, fạll; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, wȯn, fôr, nŏt, dọ; cūre, bŭt, rụde, fụll, bûrn; *out*;

RULERS OF SPAIN

	House of Aragon
1479–1504	Ferdinand and Isabella (Union of Castile and Aragon)
1504–1516	Ferdinand, King of all Spain
	House of Hapsburg
1516–1556	Charles I
1556–1598	Philip II
1598–1621	Philip III
1621–1665	Philip IV
1665–1700	Charles II
	House of Bourbon
1700–1746	Philip V
1746–1759	Ferdinand VI
1759–1788	Charles III
1788–1808	Charles IV
1808	Ferdinand VII
	House of Bonaparte
1808–1813	Joseph Bonaparte
	Bourbon Restoration
1814–1833	Ferdinand VII
1833–1868	Isabella II
[1868–1870	Provisional Government]
	House of Savoy
1870–1873	Amadeus I
[1873–1874	First Republic]
	House of Bourbon
1875–1885	Alfonso XII
1885–1886	Maria-de-las-Mercedes
1886–1931	Alfonso XIII
[1931	Second Republic]

SELECTIONS FOR THE NATIONAL STATUARY HALL

State	Name	Date	Activity	Date Statue Accepted
Alabama	Joseph Wheeler	1836–1906	General in the Confederate army	1925
	Jabez Lamar Monroe Curry	1825–1903	United States minister to Spain	1907
Arizona	John Campbell Greenway	1872–1926	General manager, Calumet and Arizona mining company, Bisbee	1930
Arkansas	Uriah M. Rose	1834–1913	Lawyer and political leader	1917
	James P. Clarke	1854–1916	United States senator	1921
California	Junipero Serra	1713–84	Franciscan missionary	1931
	Thomas Starr King	1824–64	Orator. Helped keep California in Union	1931
Connecticut	Roger Sherman	1721–93	On committee to draft Declaration of Independence	1872
	Jonathan Trumbull	1710–85	First state governor of Connecticut	1872
Delaware	Caesar Rodney	1728–84	Signer of Declaration of Independence	1926
	John M. Clayton	1796–1856	United States senator	1926
Florida	John Gorrie	1803–55	Invented ice-making machine	1914
	Edmund Kirby Smith	1824–93	General in Confederate army	1918
Georgia	Alexander Hamilton Stephens	1812–83	Vice-president of Confederacy	1927
	Crawford W. Long	1815–78	Pioneer in use of ether	1926
Idaho	George Laird Shoup	1836–1904	Last territorial and first state governor	1909–10
	William E. Borah	1865–1940	Political leader	1947
Illinois	Frances Elizabeth Willard	1839–98	Temperance leader	1905
	James Shields	1810–79	General in Civil War	1893
Indiana	Lewis (Lew) Wallace	1827–1905	General, United States Army. Author	1909–10
	Oliver Perry Morton	1823–77	Civil War governor of Indiana	1899
Iowa	Samuel Jordan Kirkwood	1813–94	U. S. senator and secretary of interior	1913
	James Harlan	1820–99	U. S. senator and secretary of interior	1909
Kansas	John James Ingalls	1833–1900	United States senator	1904–05
	George Washington Glick	1827–1911	Governor of Kansas	1914
Kentucky	Henry Clay	1777–1852	American political leader	1929
	Ephraim McDowell	1771–1830	American surgeon	1929
Louisiana	Huey Pierce Long	1893–1935	United States senator	1941
Maine	Hannibal Hamlin	1809–91	Vice-president of the United States	1934
	William King	1768–1852	First governor of Maine	1878
Maryland	Charles Carroll	1737–1832	Signer of Declaration of Independence	1902–03
	John Hanson	1715–83	President of Continental Congress	1902–03
Massachusetts	Samuel Adams	1722–1803	Revolutionary patriot	1873
	John Winthrop	1588–1649	First colonial governor	1875
Michigan	Lewis Cass	1782–1866	Cabinet officer under Van Buren	1889
	Zachariah Chandler	1813–79	United States senator	1913
Minnesota	Henry Mower Rice	1817–94	First United States senator from Minn.	1916
Mississippi	Jefferson Davis	1808–89	President of Confederacy	1931
	James Zachariah George	1826–97	United States senator	1931
Missouri	Thomas Hart Benton	1782–1858	United States senator	1899
	Francis P. Blair, Jr.	1821–75	General in Civil War	1899
Nebraska	William Jennings Bryan	1860–1925	Orator and statesman	1937
	Julius Sterling Morton	1832–1902	Journalist and statesman	1937
New Hampshire	Daniel Webster	1782–1852	Statesman and orator	1894
	John Stark	1728–1822	Revolutionary soldier	1894
New Jersey	Richard Stockton	1730–81	Signer of Declaration of Independence	1888
	Philip Kearny	1815–62	General in Civil War	1888
New York	Robert R. Livingston	1746–1813	On committee to draft the Declaration of Independence	1874
	George Clinton	1739–1812	First state governor of New York	1873
North Carolina	Zebulon Baird Vance	1830–94	Governor and United States senator	1916
	Charles Brantley Aycock	1859–1912	Governor and educator	1932
Ohio	William Allen	1803–79	Governor of Ohio	1888
	James Abram Garfield	1831–81	President of the United States	1886
Oklahoma	Sequoyah	1770?–1843	Inventor of Cherokee alphabet	1917
	Will Rogers	1879–1935	Humorist and philosopher	1939
Oregon	Jason Lee	1803–45	Missionary and Oregon pioneer	1952
	John McLoughlin	1784–1857	Explorer, fur trader, and physician	1952
Pennsylvania	Robert Fulton	1765–1815	Built first successful steamboat	1889
	John Peter Gabriel Muhlenberg	1746–1807	Officer in Revolutionary War	1889
Rhode Island	Roger Williams	1603?–83	Founder of Rhode Island	1872
	Nathanael Greene	1742–86	General in Revolutionary War	1870
South Carolina	John Caldwell Calhoun	1782–1850	American statesman	1909–10
	Wade Hampton	1818–1902	Confederate general	1929
South Dakota	William Henry Harrison Beadle	1838–1915	Pioneer and educator	1938
Tennessee	John Sevier	1745–1815	First governor of Tennessee	1931
	Andrew Jackson	1767–1845	President of the United States	1928
Texas	Sam Houston	1793–1863	President of Texas Republic	1904
	Stephen Fuller Austin	1793–1836	Founder of Texas	1904
Utah	Brigham Young	1801–77	Mormon leader	1950
Vermont	Ethan Allen	1737?–89	Hero of Ticonderoga	1875
	Jacob Collamer	1792–1865	United States senator	1881
Virginia	Robert E. Lee	1807–70	Confederate general	1908
	George Washington	1732–99	First president of United States	1908
Washington	Marcus Whitman	1802–47	Pioneer, physician, and missionary	1953
West Virginia	Francis Harrison Pierpont	1814–99	Governor of West Virginia	1903–13
	John Edward Kenna	1848–93	United States senator	1901
Wisconsin	Robert Marion La Follette	1855–1925	American political leader	1929
	Jacques Marquette	1637–75	Discovered Mississippi River	1896–1904

Statues listed first under each state are located in National Statuary Hall. Those listed second are in other parts of the Capitol.

Statute of Westminster, English history E-371, B-319

Statutes of Limitations. *See in Index* Limitations, Statutes of

Staubbach (*shtoub'bäĸ*), waterfall in Switzerland, s. of Lauterbrunnen: height 980 ft.

Staun'ton, Va., city 100 mi. n.w. of Richmond; pop. 19,927; furniture, clothing, flour; occupied by Union troops in 1864; birthplace of President Woodrow Wilson; Mary Baldwin College and Staunton Military Academy; state school for deaf and blind: *map* V-486

Staunton River, upper Roanoke River above junction with Dan River, V-480

Staupitz (*shtou'pits*), **Johann von** (1460?–1524), German Roman Catholic theologian; professor of theology at Wittenberg and vicar-general of the Augustinian Order in Germany; early friend and adviser of Luther.

Stau'rolite, cross-stone, or fairy stone, a reddish-brown iron aluminum

principle used in three-dimensional movies M-434
Stereoscop'ic camera S-392
Ster'eotyping, in printing S-393, N-186, *picture* N-187
stereotypes, why made P-414
Steriliza'tion A-265
in canning F-220, *222*
in first aid F-96*b*, 95
Sterlet, a sturgeon S-434
Sterling, George (1869–1926), poet, born Sag Harbor, N.Y.; lived chiefly in and near San Francisco; influenced by Ambrose Bierce; wrote exotic lyric and dramatic poetry ('Testimony of the Suns', 'Wine of Wizardry', 'Caged Eagle').
Sterling, John (1806–44), Scotch-Irish poet and essayist, born Bute, island off s.w. coast of Scotland; in 1838 formed Sterling Club, literary group including Tennyson, Carlyle, and John Stuart Mill.
Sterling, Colo., farming center in n. e., 120 mi. from Denver; pop. 7534; large beet-sugar factory: *maps* C-409, U-252
Sterling, Ill., city on Rock River, 107 mi. w. of Chicago; in rich agricultural region; pop. 12,817; dairy and hardware products: *map* I-36
Sterling, a term designating standard quality, applied especially to the English gold sovereign; word probably from Old English *steorling,* coin with a star (from *steorra,* star), some early Norman pennies bearing a small star; Norman penny known for uniform excellence.
Sterling area, countries with all currencies related to value of sterling and with monetary reserves chiefly in sterling; area includes Great Britain, Commonwealth countries (*except Canada*), British colonies, and certain non-British countries: I-196
Sterling Memorial Library, one of the libraries at Yale University; dedicated 1931; more than 2,000,000 volumes; gift of John W. Sterling estate.
Sterling silver, composition A-174
Stern, G(ladys) B(ronwyn) (Mrs. Geoffrey Lisle Holdsworth) (born 1890), English novelist, born London, England (tetralogy of novels about a Jewish family: 'The Matriarch Chronicles'; criticism with Sheila Kaye-Smith: 'Speaking of Jane Austen'; 'More about Jane Austen').
Stern, Otto (born 1888), American physicist, born Sorau, Germany; moved to U.S. 1933, became citizen 1939; since 1933, physics professor Carnegie Institute of Technology; received 1943 Nobel prize in physics "for his contributions to the atomic ray method and his discovery of the magnetic moment of the proton."
Sternberg, George Miller (1838–1915), U.S. Army surgeon, born Otsego County, N. Y.; helped to check epidemics of cholera and yellow fever in Cuba; made important studies in bacteriology.
Sterne, Emma Gelders (born 1894), author, born Birmingham, Ala.; stories for young people blend history and romance ('Loud Sing Cuckoo', Chaucer's England; 'Calico Ball', reconstruction in Alabama after the Civil War; 'The Long Black Schooner', mutiny on the *Amistad* by kidnapped Negroes 1839).
Sterne, Laurence (1713–68), British author and clergyman, one of the first great English novelists; noted for humor and artistic sentimentalizing; helped to make novel a study of character and not merely a story: E-378*a*, N-311
autographed books B-246
Sterne, Maurice (born 1878), American painter, sculptor, and etcher, born Russia; moved to New York City at age of 12; traveled extensively, portraying people and life; painting influenced by French moderns; sculptural works boldly modeled.
Stern Group, underground organization in Palestine P-47
Sternum, the breastbone S-191, *picture* S-192, *color picture* P-240
Sternway. *See in Index* Nautical terms, *table*
Stern-wheeler steamboat with paddle wheel at stern, *picture* M-322
Sterols V-496, 498
Stethoscope (from Greek, meaning "to inspect the chest"), a medical instrument for listening to respiratory, cardiac, and other sounds within the body; invented by René Laënnec about 1819
how it increases sound S-239
Stetson, Augusta Emma (1842–1928), religious leader, born Waldoboro, Me.; helped to organize First Church of Christ, Scientist, New York; dismissed from mother church 1909, on charges of insubordination; conducted advertising campaign on behalf of her doctrines.
Stetson, Harlan True (born 1885), astronomer and geophysicist, born Haverhill, Mass.; on faculty Harvard University 1916–29, 1933–36; research associate Massachusetts Institute of Technology after 1936; specialized in photometric researches, sunspot and radio correlations, lunar effect on radio transmission and earthquakes.
Stetson University, at De Land, Fla.; Baptist; founded 1883; arts and sciences, business, law, music; graduate study.
Stettin (*shtĕ-tēn'*), Polish **Szczecin** (*shchĕ'chin*), Poland, former German port on Oder River 17 mi. above mouth; included in Poland since 1945; pop. 200,217; manufactures; former port of Berlin; medieval buildings: *maps* E-416, P-344
Stettinius, Edward Reilly (1900–1949), industrial executive, public official, born Chicago, Ill.; official, U. S. Steel Corp., 1934–40; on National Defense Advisory Commission 1940–41; administrator lend-lease office in OEM 1941–43; undersecretary of state 1943–44; secretary of state 1944–45; representative in United Nations Security Council 1945–46; made rector of University of Virginia Aug. 1946.
Steu'ben (*stū'bĕn*, German *shtoi'bn*), **Frederick William Augustus, baron von** (1730–94), German officer in American Revolutionary War S-393
drilling soldiers, *picture* R-128
Steubenville, Ohio, city on Ohio River, 35 mi. s.w. of Pittsburgh, in coal, clay, natural gas, and oil region; pop. 35,872; iron and steel products, tin plate, pottery, glass: *maps* O-356, U-253
Steu'nenberg, Frank (1861–1905), governor of Idaho 1897–1901; born Keokuk, Iowa: I-25
Stevens, Albert William (1886–1949), engineer and stratosphere research specialist, born Belfast, Me.; aerial photographic specialist in World War I and later in South America in 1924 and 1930
stratosphere flight (1935), *picture* B-35
Stevens, Alfred (1817–75), English sculptor, worked nearly 20 years on duke of Wellington monument and tomb in St. Paul's Cathedral: S-80
Stevens, Alfred (1828–1906), Belgian painter, whose finished technique and careful execution greatly influenced many of his contemporaries; particularly successful in portraits of ladies of fashion ('Preparing for the Ball').
Stevens, Isaac Ingalls (1818–62), American soldier, governor of Washington Territory (1853–57); saw service with Army engineer corps in Mexican War and in coast survey office 1849–53; director of survey of northern railway route between St. Paul, Minn., and Puget Sound; criticized as governor for handling of Indian affairs, but later vindicated; territorial delegate (1857–59); major general of New York volunteers in Civil War; killed in battle of Chantilly.
Stevens, John (1749–1838), engineer and inventor, born New York City; helped secure American patent system; built *Phoenix*, a seagoing steamboat, 1807, which ran successfully on Delaware River
early railroads R-59
invents screw propeller S-154
Stevens, Risë (born 1913), contralto, born New York City; studied in Europe; debut in Prague 1936; joined Metropolitan Opera, N. Y. City, 1938; also concert, radio, motion-picture, and television work.
Stevens, Robert Livingston (1787–1856), mechanical engineer, naval architect, and inventor, born Hoboken, N. J.; son of John Stevens; in 1830 designed railway rail with flanged T-section still in use; also designed and built steamships and sailing vessels (*Maria*, fastest of its day): R-61
Stevens, Robert T(en Broeck) (born 1899), public official, born Fanwood, N.J.; in 1921 joined J. P. Stevens & Co., Inc. (textile manufacturers), New York City, chairman of board 1945–53; class C chairman Federal Reserve Bank of New York 1948–53; secretary of the army 1953–55.
Stevens, Thaddeus (1792–1868), statesman, born Danville, Vt.; abolitionist, bitter critic of compromise measures before Civil War and conciliation after; congressman from Pennsylvania; head of committee charged with impeaching President Johnson: R-85*b*
Stevens, Wallace (born 1879), poet and insurance executive, born Reading, Pa.; poems have irony, wit, and polish ('Harmonium'; 'Ideas of Order'; 'Parts of a World'; 'Transport to Summer'; 'Three Academic Pieces').
Stevens Institute of Technology, at Castle Point, Hoboken, N. J.; for men; founded 1870; engineering; graduate school.
Stevenson, Adlai Ewing (1835–1914), statesman, born Christian County, Ky.
vice-president of U.S. *See in Index* Vice-president, *table*
Stevenson, Adlai Ewing (born 1900), public official, grandson of above, born Los Angeles, Calif.; received law degree from Northwestern University 1926; special counsel, Agricultural Adjustment Administration, 1933–34; special assistant to secretary of the navy 1941–44 and to secretary of state 1945; worked in United Nations 1945–47; governor of Illinois 1949–53; Democra-

SUPREME COURT OF THE UNITED STATES

	Born	Year of Appointment	Appointed by
Earl Warren (Chief Justice)	1891	1953	Dwight D. Eisenhower
Hugo La Fayette Black	1886	1937	Franklin D. Roosevelt
Stanley Forman Reed	1884	1938	Franklin D. Roosevelt
Felix Frankfurter	1882	1939	Franklin D. Roosevelt
William Orville Douglas	1898	1939	Franklin D. Roosevelt
Harold H. Burton	1888	1945	Harry S. Truman
Thomas C. Clark	1899	1949	Harry S. Truman
Sherman Minton	1890	1949	Harry S. Truman
John Marshall Harlan	1899	1955	Dwight D. Eisenhower

CHIEF JUSTICES OF THE UNITED STATES

John Jay	1789–95
John Rutledge	1795
Oliver Ellsworth	1796–99
John Marshall	1801–35
Roger B. Taney	1836–64
Salmon P. Chase	1864–73
Morrison R. Waite	1874–88
Melville W. Fuller	1888–1910
Edward D. White	1910–21
William H. Taft	1921–30
Charles Evans Hughes	1930–41
Harlan Fiske Stone	1941–46
Frederick Moore Vinson	1946–53
Earl Warren	1953–

RULERS OF SWEDEN (FROM 1523)

House of Vasa	
1523–1560	Gustavus I, Vasa
1560–1569	Eric XIV
1569–1592	John III
1592–1599	Sigismund III
1599–1604	Charles (Protector of the realm up to 1604 when crowned as Charles IX)
1604–1611	Charles IX
1611–1632	Gustavus II, Adolphus
1632–1654	Christina
House of Pfaltz	
1654–1660	Charles X
1660–1697	Charles XI
1697–1718	Charles XII
1718–1720	Ulrica Leonora
House of Hesse	
1720–1751	Frederick I
House of Holstein-Gottorp	
1751–1771	Adolphus Frederick
1771–1792	Gustavus III
1792–1809	Gustavus IV
1809–1818	Charles XIII
House of Bernadotte	
1818–1844	Charles XIV (John)
1844–1859	Oscar I
1859–1872	Charles XV
1872–1907	Oscar II
1907–1950	Gustavus V
1950–	Gustavus VI, Adolphus